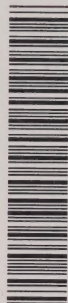


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# Ontario Research Commission

## INTERIM REPORT

FEBRUARY

1947

PRINTED BY ORDER OF  
THE LEGISLATIVE ASSEMBLY OF ONTARIO  
SESSIONAL PAPER No. 47, 1947



ONTARIO

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TO THE HON. RAY LAWSON, O.B.E.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to your Honour the Interim Report of the Ontario Research Commission.

Respectfully submitted,

D. R. MICHENER.  
Provincial Secretary.

Department of the Provincial Secretary.  
February 6th, 1947.





December 4th, 1946

THE HONOURABLE D. R. MICHENER,  
Provincial Secretary,  
Province of Ontario,  
Toronto, Ontario.

Dear Mr. Michener:

It is my privilege to transmit herewith a report of progress of the Ontario Research Commission, pursuant to Order-in-Council dated August 28th, 1945.

I have the honour to be, sir,

Your obedient servant,

R. C. WALLACE,  
Chairman.

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## TERMS OF REFERENCE

### ONTARIO

#### EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by the Honourable, the Lieutenant-Governor, dated the 28th day of August, A.D. 1945.

Upon the recommendation of the Honourable the Prime Minister, the Committee of Council advise that pursuant to the provisions of The Public Inquiries Act, R.S.O. 1937, chapter 19,

Dr. R. C. Wallace	E. Holt Gurney	Dr. Sidney Smith
W. E. Phillips	Dr. R. K. Stratford	Dr. G. I. Christie
H. M. Turner	Dean C. R. Young	Dr. T. H. Hogg
Dr. C. E. Burke, and	Dr. W. Sherwood Fox	

be appointed commissioners to inquire into and report upon all matters concerned with scientific and industrial research as they affect the Province of Ontario and in particular to inquire into and report upon,

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario.

The Committee further advise that Dr. R. C. Wallace be appointed chairman of the Commission and that Professor J. O. Wilhelm be appointed Secretary of the Commission.

And the Committee further advise that the said Commissioners shall have the power to summon any person and require him to give evidence on oath and to produce such documents and things as the commissioners deem requisite for the full investigation of the matters into which they are appointed to examine, by subpoena signed by the chairman or by any one of the commissioners hereby appointed.

Certified.

"C. F. BULMER,"  
Clerk, Executive Council.

## ONTARIO

### EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by The Honourable the Lieutenant-Governor, dated the 23rd day of July, A.D. 1946.

The Committee of Council have had under consideration the report of the Honourable the Provincial Secretary, dated July 18th, 1946, wherein he states that.—

WHEREAS, under the provisions of The Public Inquiries Act, a Commission under the Great Seal bearing date the twentieth-eighth day of August, 1945, appointed Dr. R. C. Wallace et al to inquire into and report upon

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario;

AND WHEREAS it is deemed expedient that E. T. Sterne of the City of Brantford should be associated in the said inquiry;

The Honourable the Provincial Secretary therefore recommends that, pursuant to the provisions of the said The Public Inquiries Act, the said E. T. Sterne be appointed a Commissioner for the purposes in the aforesaid Commission contained and recited to be associated for that purpose with the Commissioners therein named, fully and effectually giving and granting unto the said E. T. Sterne all and every the like powers given and granted by the said Commission to the said Commissioners as if the said E. T. Sterne had been appointed by the Commission aforesaid.

The Committee of Council concur in the recommendation of the Honourable the Provincial Secretary, and advise that the same be acted upon.

“C. F. BULMER,”  
Clerk, Executive Council.

# HISTORY OF ONTARIO RESEARCH COMMISSION

## Appointments

The Ontario Research Commission was appointed by Order-in-Council dated August 28th, 1945, under authority conferred by The Public Inquiries Act, R.S.O. 1937, Chapter 19. The Commissioners appointed were—

	Dr. R. C. Wallace, Chairman	
Mr. E. Holt Gurney	Dr. Sidney Smith	Mr. W. E. Phillips
Dr. R. K. Stratford	Dr. G. I. Christie	Mr. H. M. Turner
Dr. C. R. Young	Dr. T. H. Hogg	Dr. C. E. Burke
	Dr. W. Sherwood Fox	

Owing to the prolonged illness of Dr. Christie, **Mr. W. R. Reek** was asked to act during his absence. The Commissioners wish to express their appreciation of the services he has rendered. By Order-in-Council dated July 23rd, 1946, **Mr. E. T. Sterne** was appointed to the Commission. The appointment of Mr. Sterne was welcomed by the original Commissioners because, aside from the personal contributions Mr. Sterne has made, he represents to the Commission the viewpoint of smaller industries.

The Order-in-Council of August 28th, 1945, appointed Professor J. O. Wilhelm as Secretary of the Commission. His appointment was made possible by an arrangement with the Physics Department of the University of Toronto. On October 2nd, 1945, by Order-in-Council, Miss K. Huff was appointed Secretarial Stenographer.

## Accommodation

The Commission has been housed in two offices generously provided by the Ontario Research Foundation at 43 Queen's Park. Facilities for the Commission and Committee meetings have been provided by the Ontario Research Foundation, the University of Toronto, the Ontario Agricultural College, Queen's University, the Horticultural Experimental Station (Vineland), and the Provincial Parliament Buildings. The thirteenth and fourteenth meetings of the Commission were held at Niagara Falls.

## The Task

The Order-in-Council appointing the Commission imposed on it, either expressly or by implication, the task of inquiring into and reporting on the conditions pertaining to scientific personnel and scientific facilities, on the possibilities of co-ordination and integration of research work in the Province, and on the role the Government of the Province might assume in any overall programme of research. The task assigned involved the investigation of the work done and being done by the various research agencies, both public and private, together with consideration of the programmes planned by each, with a view to making recommendations for the possible direction of their efforts into channels which will eliminate any danger, real or imaginary, of duplication of effort.

## The Method

Accepting the thesis that it should play the role of advisor and co-ordinator only, and not an instrument of research in itself, the Commission adopted the policy of setting up Advisory Committees, each committee consisting of repre-



sentatives of groups or institutions vitally concerned in a particular field. The usual procedure was to invite such representatives to a conference at which one of the Commissioners and the Secretary were present. The Commissioner acted as chairman, and outlined to those present the purpose of the Commission, inviting their co-operation in the achievement of its aim. Each group was encouraged to elect its own chairman, and to function, with the help of the Commission in Secretarial and financial matters, as an independent unit. The members were invited to suggest others for membership on the Committee, and each was encouraged to submit to the group the plans and needs of the organization which he served. It was the duty of the Committee, when all available information was at hand, to co-ordinate the whole, and submit to the Commission a complete report of its findings and its recommendations. In the case of Forestry, where the whole field was readily divisible into the phases of Production and of Utilization, sub-committees were formed to consider each phase, and, following their submissions, a joint session provided an opportunity for consideration of the whole problem. Whenever possible, the Commissioners attended meetings of the advisory committees, in order that they might have a clearer understanding of all the factors. The task of the Commission has been made much easier and much happier by the splendid spirit of co-operation displayed by the various groups with which it has worked. That spirit is, of course, merely an extension of the amicable relationships which have been built up over a period of years among those groups concerned with research.

### Commission Meetings

The following is a schedule of the meetings held by the Commission during the past year—

September 10th, 1945.....	Ontario Research Foundation
October 15th, 1945.....	Ontario Research Foundation
November 14th, 1945.....	Ontario Research Foundation
December 10th, 1945.....	Ontario Research Foundation
January 17th, 1946.....	Ontario Research Foundation
February 13th, 1946.....	Simcoe Hall, University of Toronto
March 6th, 1946.....	Simcoe Hall, University of Toronto
April 17th, 1946.....	Simcoe Hall, University of Toronto
May 8th, 1946.....	Simcoe Hall, University of Toronto
June 19th, 1946.....	Simcoe Hall, University of Toronto
July 11th, 1946.....	Ontario Agricultural College
**September 18th, 1946.....	Ontario Research Foundation
October 12th-14th, 1946.....	Niagara Falls
November 30th-December 1st, 1946.....	Niagara Falls
December 11th, 1946.....	Ontario Research Foundation
December 11th, 1946 (with Cabinet Committee).....	Provincial Parliament Buildings
January 15th, 1947.....	Simcoe Hall, University of Toronto

\*\*Preliminary Industrial Research meeting.

## GENERAL STATEMENT

Research is proving to be the basis on which sound progress is being made in the expansion of industry and in the development of natural resources. In this Province the responsibility for research is assumed partly by the government and partly by industry, the universities, the Ontario Research Foundation and other agencies. At present, because of a shortage of trained personnel and facilities for research, any budget for a programme of expansion will have to be small in the beginning, increasing progressively as conditions permit. Moreover, in order to develop research teams on the most efficient basis, continuity must be ensured for a large part of the programme. This means not only that one must expect moderate expenditures at once, but also that, in some cases, financial provision must be made on a long-term basis.

Since the development and extension of research in Ontario is vitally dependent upon the availability of trained personnel, the Commission would recommend that the Department of Education, the universities, the technical institutions, and the industry of the Province promote and expedite in every possible way the training of persons who can give useful assistance in this field.

The Commission wishes to emphasize the fact that senior members of the staffs of universities have very heavy teaching duties because of the unusually large registration of students that now obtains. They are unable to give adequate time to the training of graduate students in research. With additional financial assistance the universities would be able to add suitable men to their staffs in order to meet this need. Action of this kind would produce very valuable results by increasing the number of young scientists urgently required to undertake research both in pure and in applied science. The Treasury grants to the British universities are being greatly increased for the purpose of accelerating the training of skilled research workers.

The Ontario Research Commission is of the opinion that an important contribution to the desired end may be made by furthering the training of technicians in courses of the technical institute type, courses that extend over a period of one or two years and are of a grade lying between that of the vocational high schools and that of the universities. The assistance of an adequate number of persons trained in such courses would approximately double the effectiveness of the present appallingly small number of qualified research workers who have been trained in the universities.

At the same time, the Commission desires to commend in general the longer and more advanced programmes of educational training in industry as productive of persons valuable to research. It is to be hoped that industry will be able to extend this service.

Though the provision of certain research facilities and the maintenance of interest in research is one of the functions of university departments, the Commission feels that assistance to students by way of scholarships and assistance to the universities in the carrying out of specific research projects will be a major factor in promoting the training of research workers and in the actual development of basic research. To further this purpose the Commission recommends that a sum of fifty thousand dollars (\$50,000.00) be made available for scholarships, these to be granted to specially selected graduate students to assist them in securing their graduate training. In addition, through the medium of Advisory Committees in the fields of Agriculture, Fisheries and Wildlife, Forestry, Mines,

Minerals and Metallurgy, and Soils, the Commission is recommending specific projects for which support should be given. These projects are co-ordinated with the work being done by Dominion Government departments, Provincial Government departments, universities, industry and all such other agencies as are actively interested in the particular field concerned. The situation in regard to research in the various fields and the cost of the projects recommended are summarized in the appendices attached to this report.

The Commission is of the opinion that industry in the Province has to be much more adequately informed on the value of research and on the results of research which may be helpful to individual industries. The distribution of information of this kind may be effected by setting up a system of "extension" and the initiation of some form of co-operative effort in which the industries and government are jointly engaged. In the beginning government may be asked to assume a considerable proportion of the expense. As industry takes over more and more of the responsibility of the programme, it would be reasonable to expect that the government's share would be reduced. In Britain the government at present is carrying from 25% to 40% of the cost of the research which is being done by trade research associations.

The amount to be spent on research by any industry, government body, university, or foundation, is not easy to justify on an economic basis in terms that meet the requirements of boards of directors and treasury officials. General figures can, however, be given and from the comparison of such figures a reasonable guide may be found.

	Amount Spent	Year
<b>CANADA</b>		
Industry (280 firms).....	\$ 10,750,000	1944
National Research Council (not including war research).....	6,378,000	1944
*Universities (\$441,899 from N.R.C. on war research)	1,251,050	1944-45
<b>U.S.A</b>		
Industry.....	300,000,000	1940
<b>BRITAIN</b>		
Industry.....	25,000,000	1938
Research Associations.....	4,000,000	1943
Department of Scientific and Industrial Research (To the Universities of Britain for research).....	45,000,000	1946
Sir Ernest Simon estimates (University expenditures for research).....	125,000,000	1955
*Alberta, British Columbia, Manitoba, McMaster, Queen's, Saskatchewan, Toronto and Western Ontario.		

It is obvious that if Ontario, representing as it does 40% of Canadian industrial potential, is to go forward and maintain its place in the markets of the world research facilities must be extended. To do this will require increasing sums of money for research and on a basis ensuring reasonable continuity to attract the best of our technical personnel into research fields. A factor which should also be borne in mind is the necessity of maintaining freedom of action for research groups in the selection of their research programmes.

The recommendations for Provincial support of research† which are made herewith, are strictly within the area of Provincial responsibility and are closely co-ordinated with the responsibilities of the Dominion Government departments working in related fields. Care has been taken to see that representatives of the Federal departments concerned sit with the Commission's advisory committees at all stages of the planning. This course has been followed in order to ensure close co-ordination in order that public funds be used to the fullest advantage.



Research to be effective must be done close to the ultimate user of its results. On this account proximity of the research to the ultimate consumer gives better and quicker benefits. Although, in a confederation such as we have in Canada, a great deal of work must of necessity be done by the Dominion Government for all the people of Canada, nevertheless much of the research work must be done by groups which are close to local conditions. One of the best forms of training in the administration of any problem is a thorough experience in research in the field. An industry, government department, or university, with a strong research group working within the staff, is fitted much better to attack daily problems. The question of putting such a belief into dollars and cents, however, is not by any means an easy matter. The Provincial Departments, when requested for figures on research expenditures found it difficult to give an answer that stated the case clearly. It was only after considerable discussion that a consistent report could be prepared giving a summary of expenditures on research. It is hoped that, by further co-operation along these lines and by assistance from the Provincial Bureau of Statistics and Research, figures will be produced in such a way that economic principles may be applied and some measure of comparison may be set up to indicate the true value of research expenditures.

The Appendices submitted herewith and attached to the statement of financial requirements for the fiscal year 1947-48, summarize the preliminary findings of the Commission and its Advisory Committees. A final report will be submitted early in 1948.

### †SUMMARY OF RECOMMENDED EXPENDITURES FOR RESEARCH—1947-1948

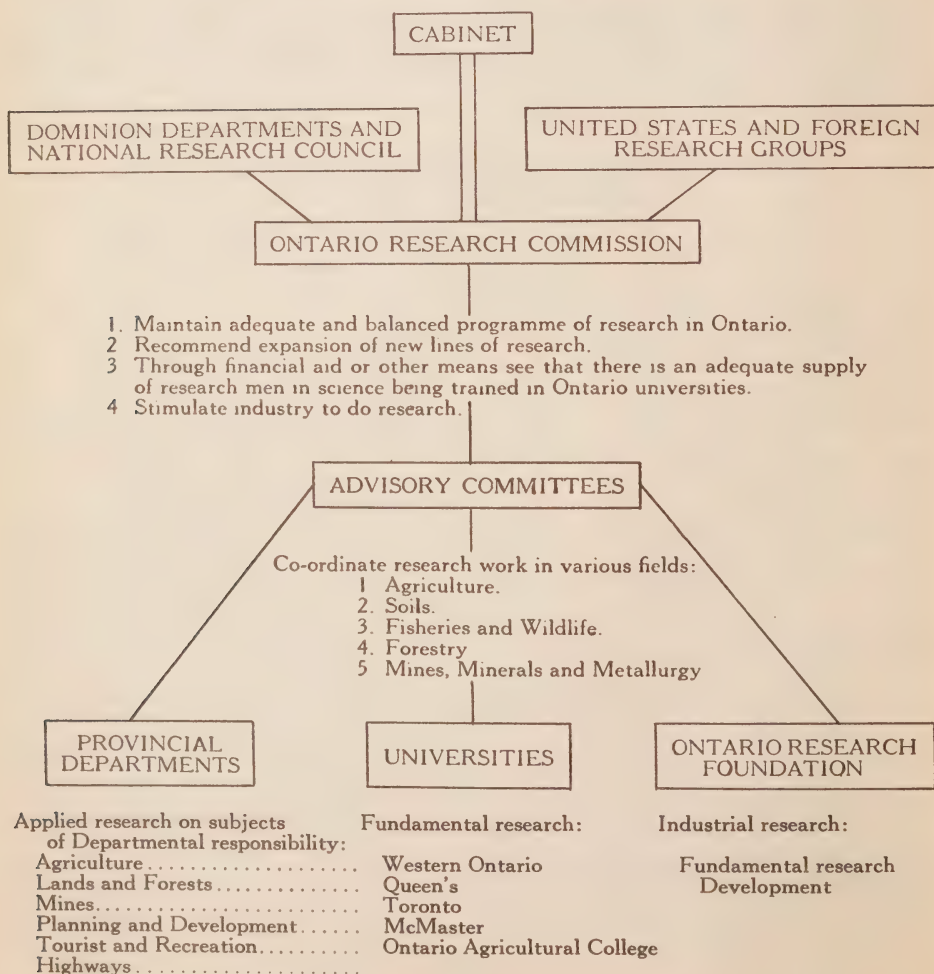
	Capital \$	Operating \$	Total \$	
<b>FISHERIES AND WILDLIFE COMMITTEE</b>				
University of Toronto . . . . .	1,000.00	12,575.00	13,575.00	
Royal Ontario Museum of Zoology . . . . .	1,000.00	6,500.00	7,500.00	
McMaster University . . . . .	6,100.00	10,480.00	16,580.00	
Queen's University . . . . .	4,360.00	3,240.00	7,600.00	
University of Western Ontario . . . . .	9,273.00	13,304.00	22,577.00	
Ontario Research Foundation . . . . .	2,000.00	20,000.00	22,000.00	\$ 89,832.00
<b>FORESTRY COMMITTEE</b>				
Queen's University . . . . .		1,590.00	1,590.00	
Ontario Research Foundation . . . . .	2,000.00	18,000.00	20,000.00	
Unclassified as yet (sawmill practice) . . . . .			25,000.00	46,590.00
<b>AGRICULTURAL COMMITTEE</b>				
Ontario Research Foundation . . . . .	2,000.00	18,000.00	20,000.00	20,000.00
<b>SOILS COMMITTEE</b>				
Ontario Research Foundation . . . . .	2,100.00	14,900.00	17,000.00	17,000.00
<b>MINES, MINERALS AND METALLURGY COMMITTEE</b>				
Ontario Research Foundation . . . . .	12,000.00	32,000.00	44,000.00	
Unclassified as yet . . . . .			56,000.00	100,000.00
<b>INDUSTRIAL RESEARCH</b>				
Ontario Research Foundation . . . . .		65,000.00	65,000.00	65,000.00
<b>SCHOLARSHIPS (recommended by Ontario Research Commission) . . . . .</b>				50,000.00
				<b>\$388,422.00</b>

# PROVINCIAL GOVERNMENT DEPARTMENTS RESEARCH EXPENDITURES—1946-1947

Department of Agriculture .....	\$283,647.00
*Department of Education .....	77,000.00
*Department of Health .....	73,250.00
Department of Highways .....	50,000.00
Department of Lands and Forests .....	198,610.00
Department of Mines .....	131,000.00
Department of Planning and Development .....	3,000.00
*Department of Welfare .....	10,000.00
	<hr/> \$835,707.00
Ontario Hydro-Electric Power Commission .....	<hr/> \$109,600.00
TOTAL .....	<hr/> \$945,307.00

\*These departments are not considered to come under the review of the Ontario Research Commission.

## PROVINCE OF ONTARIO



## CONCLUSIONS

1. Research, to an extent greater than ever before, must be the foundation on which the economy of the Province is built.
2. Since the development and extension of research and, in consequence, of industrial progress in Ontario, is vitally dependent upon the availability of trained personnel, the Ontario Research Commission recognizes that the Department of Education, the Universities, the technical institutions, and the industry of the Province individually and collectively have significant roles to play in the training of persons who can give useful assistance in field.
3. The Commission wishes to emphasize the fact that senior members of the staffs of universities have very heavy teaching duties because of the unusually large registration of students. They are unable to give adequate time to the training of graduate students in research. With additional financial assistance suitable men could be added to the staff in order to meet this need. This would be productive of very valuable results in increasing the number of scientists available for the urgent demands both in pure and in applied science. The Treasury Grants to the British Universities are being increased greatly in order that training in scientific research may be expedited.
4. The Commission is of the opinion that an important contribution to the carrying on of fundamental and applied research may be made by furthering the training of technicians in courses of the technical institute type extending over a period of one or two years at a level lying between that of the vocational high schools and that of the universities. The assistance of an adequate number of such persons would approximately double the effectiveness of the all too few fully qualified university graduate research workers.
5. The Commission desires to commend in general the longer and more advanced programmes of educational training in industry as productive of persons valuable to research. It is to be hoped that industry may be able to extend this service.
6. The facilities for research, in every field, require expansion, in equipment as well as in staff, and a larger measure of continuity to embrace long term problems is a necessary condition to future progress.
7. In most fields of research, despite the fact that there has been a multiplicity of research agencies, there has been a minimum of duplication of effort, due to the co-operation of the institutions concerned.
8. Provisions should be made so that discoveries resulting from research in our public institutions may be patented, with a view to ensuring that the financial gains arising from those discoveries are used to further research.
9. The successful "extension" policy of the various departments of agriculture warrants its introduction into other fields.
10. The Commission is of the opinion that industry in the Province has to be much more adequately informed on the value of research and on the results of research which may be helpful to individual industries. This is largely a question of "extension" and some form of co-operative effort in which the industries and government are jointly engaged. In the beginning govern-

ment may be asked to assume a considerable proportion of the expense. As industry takes over more and more of the responsibility of the programme the government share can be reduced. In Britain the government at present is carrying from 25% to 40% of the cost of the research which is being done by trade research associations.

11. Research on markets and on marketing must be, no longer, something of an afterthought. It is not a matter so much of scientific research as a question of the application of economic principles to production and marketing and should be a matter of study by an economic group.
12. In certain fields, for example agriculture, fisheries and wildlife and soils, the Governments must continue to assume major responsibility for research in the production field, and both Government and industry should begin work on the utilization of agricultural products and by-products.
13. In certain industrial fields, for example mining and minerals, Governments must continue to assume some responsibility, notably in the provision of research facilities beyond the means of private enterprise.
14. In many fields, existing organizations are competent to carry out a comprehensive Province-wide research programme, if provision is made for an expansion of facilities and personnel.
15. The activities of the Dominion Government in the field of research make it imperative that a close liaison be maintained at all times, if undesirable duplication is to be avoided and full use of available facilities is to be enjoyed.
16. Any marked extension of research activity in the Province will necessitate continuing, careful co-ordination of the efforts of all if fullest use of limited funds, limited personnel and limited facilities, is to be realized.



## RESEARCH AND RESEARCH PERSONNEL

"There is probably more talk about research and its value in the post-war years than has ever occurred before. This is not confined to technical groups, but is featured in the public press, with the result that Government, industry and the public are becoming increasingly aware of what research can do—not only for the various organizations who expect to profit by such work—but what it may mean to people as a whole."\*

The expansion of the research programme of the Dominion Government and the establishment of Provincial bodies, such as the Ontario Research Commission and the Nova Scotia Research Foundation, to investigate or direct research, reflects that public interest. That interest is a logical and commendable one, but it must be properly utilized and directed. Otherwise it can, unfortunately, lead to a great deal of loose, wishful and badly co-ordinated thinking.

The Ontario Research Commission recognizes the urgent need for research—research that is purposeful and that is co-ordinated. It believes that the objective of that research is the material objective of civilization itself—to prolong life, to improve health and comfort, to enhance happiness, and to enlarge productive ability and usefulness. The Commission recognizes, too, that research workers constitute the main reconnaissance staff in the attainment of that objective and feels that, because the research workers occupy that position, the problems of scientific personnel may best be discussed with the broader problem of research in general. Any co-ordinated long-term research programme implies the training and maintaining of competent staff; the justification for one is the justification for the other, and the success of the one will depend on the success of the other.

In the reports which follow the necessity for research in a particular field is discussed in the report on that phase of the Commission's investigations. For that reason no complete justification for a programme of research is attempted here. It will probably be sufficient to point out that the Advisory Committee on Reconstruction, after exhaustive studies, was convinced that research was fundamental to the success of any worthwhile programme of reconstruction. It recognized, too, that any research programme would of necessity have to be instituted after careful consideration of the problem of available personnel, and that provision for the training of an adequate number of research workers was a matter of extreme urgency.

The logic of this conclusion is unassailable. In any programme the quality and the quantity of available personnel are the main limiting factors. **Unlimited facilities and unlimited funds are of little avail without qualified and interested personnel.** The research worker may overcome some of the handicaps of limited facilities or limited funds by improvisation, but there can be no improvisation to compensate for lack of personnel, whether the lack is in the number or in the quality of the workers.

There is no doubt in the minds of the Commission that there is an alarming shortage of competent help available for research. This fact was emphasized by every one of the Advisory Committees and, in certain instances, despite a general lack of funds for research as a whole, the Commission was told that the funds in hand were sufficient to finance all the research work possible in the immediate future, because there simply was no possibility of securing personnel

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\*See R. K. Stratford — The Co-ordination of Research in Canada.

to conduct the work for which money was available. In this deficiency we are not alone, for a similar situation prevails in Great Britain and in the United States. In the case of the former a special committee was set up to attempt to compensate for lack of personnel by careful co-ordination of the efforts of those available. In the United States the Science Committee reported in part as follows:

“Shortage of experienced and competent research personnel has been acute in recent years . . . and in some fields first-class men are almost unobtainable.”

This situation in the United States is of special significance to Canada and to Ontario. From the ranks of Canadian scientific personnel our neighbour is able to recruit men and women to ease the shortage which is handicapping it. It is true that we have some claim on these people—that of loyalty to Canada and appreciation of the fact that their training was and is carried out largely at the expense of their native land—but the attractions offered are, in most instances, such that it is difficult to refuse, particularly since our research has been so limited and the financial prospects rather meagre in comparison with those available in the United States. “Failure to recruit or retain,” reported the Special Committee in Great Britain, “implies successful competition.” That the competition of the United States for our personnel has been successful is readily recognized, but probably less appreciated is the fact that the “successful competition” by the Americans for personnel carries all the implications of successful competition in the struggle for markets—and we need those markets. Heretofore we have been satisfied to base our trade on the sale of our products in almost primitive form, but the demand for our basic products in that form is relatively inelastic, and this has been aggravated by the substantial decrease, due to the war, of the purchasing power of our customers. It must be realized that our chief hope of remedying what is otherwise a hopeless situation is to utilize more competently and completely our tremendous resources, directing our efforts to the frontiers of scientific research instead of to geographical frontiers as in the past. The solution is not in the production of more of the same products, but the production of consumer goods in less primitive form or in new form. To achieve that we must have research, and the prime requisite in that is, of course, adequate and competent research personnel.

Research in this country has suffered in the past both from lack of money and from a deficiency in the supply of trained research workers. The lack of money, no doubt, has been largely responsible for the inadequate supply of workers. Shortage of equipment, lack of trained assistants and of auxiliary services have together imposed an oppressive burden on the research worker, and in the case of many universities the burden of teaching has left potential high-calibre research workers little time for original investigations. There is an urgent need for better laboratories, and for more staff, not only that the teacher may have more time for research, but that he may have adequate facilities and time to instruct the students who to-morrow will man the staffs of research laboratories, university and industrial. For it is to the universities we must look, to a large extent at least, for ideas on the one hand and for men on the other.

Granted then, the urgency of the need for more adequate training facilities for the scientific personnel so badly needed, there remains the consideration of how to recruit and to retain sufficient competent research workers. The answer in both cases is the same—money; money for equipment which will enable

the research worker to carry on his work under reasonably adequate conditions; money to pay him what he is bound to be offered elsewhere; and money for the trainee in the form of fellowships, scholarships, bursaries. It is granted that very large sums are quite beyond our means, but a carefully planned programme could minimize the cost. However, it must be a complete programme. There is no advantage in providing partial training at public expense, or advanced training at further cost, only to have the personnel attracted elsewhere.

It is quite impossible to suggest a global figure required to meet satisfactorily the problem of adequate staff. Some of the Advisory Committees have endeavoured to suggest a minimum immediate programme designed to recruit interested, competent personnel. The most specific of these are outlined in the reports of the Advisory Committees but they should be considered as a mere beginning and not a complete plan. Further plans will have to be made to meet needs as they arise, and the Commission is certain that the careful objective consideration by a competent authority on suggested projects will not only prevent any waste of funds, but will produce results impossible of attainment under the present system, where research in one particular field is unlikely to be considered in the light of overall needs of the Province. It is quite obvious that a system of "priority research" would be of very great help to all, and that comparatively little additional expenditure would produce amazing results. The war has taught us what a tremendous power is represented by an organized, co-ordinated and trained team of research workers. The accumulated talents, experience and equipment of the scientists of Canada still form a gigantic reservoir whose potential energy could be quickly channelled in this direction or that, and brought to bear upon the problems, small or large, that seem most urgent at the moment. That is, they will form a reservoir as long as we ensure a constant stream of highly trained scientists to replenish the supply, and prevent, as far as possible, the draining off to competitors of those who might do for Canada what they will be asked to do for others.

It is the general judgment that Canada loses too great a proportion of her scientific personnel. During the period from January 1st, 1946 to September 30th, 1946, 574 Canadians, classed as technically trained, obtained exit permits to go to the United States.

The responsibility for retaining our trained personnel is not the direct responsibility of any one group but must be given active consideration by both government and industry.

## SCHOLARSHIPS

The Commission realizes that the need for trained personnel cannot be met completely by the provision of scholarships. Nevertheless, to assist students with ability and as an adjunct to a complete programme the provision of financial assistance to outstanding students plays a useful part.

During 1946-47 the Ontario Research Commission requested that \$20,000 be made available to provide scholarships for research students. Through recommendations from the Advisory Committees ten scholarships were granted for work to be done during the 1946-47 term. These are listed below:—



Name	University	Recommended by	Amount	Project	Supervisor
Ferguson, A. E. ....	O.A.C.	J. F. Francis	\$ 1,000	Poultry Diseases	Francis
Gartley, K. M. ....	O.A.C.	J. F. Francis	1,000	Biochemistry	Patterson
Graham, A. R. ....	Queen's	R. C. Wallace	600	Mineralogy	Berry
Curtis, E. C. ....	Queen's	J. E. Hawley			
		R. C. Wallace	500	Plant Ecology	Aikman (Iowa State)
Denyes, H. A. ....	Queen's	R. C. Wallace	1,000	Animal Ecology	Dice (Ann Arbor)
Wragg, L. E. ....	McMaster	A. E. Warren	1,000	Wildlife	Judd
Sanderson, Mrs. G. (nee Lustig) ....	O.R.F.	H. B. Speakman	2,400	Climate	Chapman
Baldwin, N. S. ....	U. of T.	E. M. Walker	500	Ichthyology	Fry
Martin, N. V. ....	U. of T.	E. M. Walker	1,000	Trout	Fry
Irvine, K. E. ....	U. of T.	R. R. McLaughlin	500	Waste Sulphite liquor	McLaughlin
Clemens, H. P. ....	U. of W.O.	W. S. Fox	500	Fresh-water cod	Battle
			<u>\$10,000</u>		

A copy of the proposed regulations governing scholarships follows.

### Regulations Regarding Scholarships

1. These scholarships are intended, not to facilitate attendance on ordinary collegiate studies, but to enable students, who have given distinct evidence of capacity for original research or students who have at least won high distinction in scientific study during their undergraduate course, to continue the prosecution of science with the view of aiding its advance or its application to the industries of the country. Evidence of this capacity is strictly required, this being the main qualification. The most suitable evidence is the submission of a satisfactory record of research already performed.
2. They are open on equal terms to men and women, and are awarded to the applicants who are deemed best qualified by the evidence submitted.
3. An applicant for scholarship must be a British subject resident in Canada.
4. An applicant to be eligible for a first award must not have passed the thirtieth anniversary of his birth on March 31st of the year of application, except in the case of war veterans.
5. A candidate must (1) be a bona fide graduate of a university or college in which special attention is given to scientific study, or (2) have received an equivalent training in an institution possessing adequate facilities of a scientific character for providing such training.
6. The departments of science in which capacity for research will be accepted as qualifying for an award are: Agricultural Sciences, Biology, Bio-Chemistry, Chemistry, Engineering, Forestry, Geography, Geology, Mathematics, Metallurgy, Mineralogy, Physics, or other approved departments.
7. Application for a scholarship must be made by the candidate to the Ontario Research Commission. He shall submit a complete record of his academic career and standing on entrance. Recommendations must be submitted from the heads of the scientific departments with which he was connected, and professors or instructors under whom he studied, showing that in their estimation he promises to be worthy of training for scientific research. All such recommendations must be forwarded to the Ontario Research Com-



- mission by the professor recommending the candidate and through the head of the department concerned. The candidate shall state the institution at which he intends to study, and the general line of work to be followed. The application will be considered and decided upon by the Ontario Research Commission or by a special committee appointed by the Commission.
8. Each applicant must arrange for his admission to some approved institution and submit with his application a statement from the supervisor under whom he intends to work in such institution that such supervisor has agreed to undertake the supervision of his work with the approval of the head of the department concerned. Such supervisor will be expected to submit to the Ontario Research Commission a confidential report on the grantee's work at the mid-year and on the conclusion of the award.
  9. The date of the beginning of tenure of an award shall coincide with the beginning of the academic session of the institution at which the grantee is to carry on his work. In very exceptional circumstances the Commission upon receipt of a formal application from a grantee, may permit a change of tenure to be made.
  10. Successful candidates are required to devote themselves for a period of at least eight months of each year wholly to the objects of the award, and during that time may hold a position of emolument or engage in teaching only with the approval of the Commission on such terms as the Commission may decide.
  11. The holder of a scholarship shall furnish on or before February 1st a detailed mid-year report of his work up to that time; and also on completion of the tenure of his award, and not later than July 31st, a complete and detailed report of the work carried on during the entire year.
  12. The Ontario Research Commission shall have the right to publish under its own auspices information arising from work done under an award, and no paper covering work carried out under an award may be published without permission from the Commission.  
In each case a copy of the manuscript shall be filed with the Commission before publication, and evidence shall be submitted that the supervisor who directed the work has approved the manuscript and the plans for publication; information shall also be furnished as to the manner in which it is proposed to publish and the expected date of publication. One reprint of the published paper shall be forwarded to the Commission as soon as available. In published papers, due credit shall be given to the Ontario Research Commission for the assistance received therefrom.
  13. The scholarships will have a value of \$500, \$900 or \$1200 depending on the experience and qualifications of the applicant.\*
  14. Awards are payable as follows: 40 per cent on beginning work; 50 per cent on receipt of a satisfactory first half-yearly report; 10 per cent after the expiration of the period of tenure and the submission to the Ontario Research Commission of a satisfactory report on the work of the holder for the whole period.
  15. Grantees who have to travel 300 miles or more may be granted, at the discretion of the Commission, an allowance toward travelling expenses. Such travel grants shall be based on the distance between the point where the award is tenable and the point where a grantee was located during the preceding year.
  16. Application for a scholarship must be made not later than February 1st.

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\*During the past year scholarships were not confined to these specific amounts since the regulations had not been finally decided upon.

## RESEARCH IN INDUSTRY

### Present Conditions in Industry

In Ontario, as in all Canada, the most striking result of the war is to be found in the rapid expansion of industrial productive capacity.\* And, even though some of the production units included in the amazing growth under the stimulus of war may be of no use to industry in times of peace, nevertheless the remaining increase of production facilities will have a profound effect not only upon the distribution of goods in the province, but in all Canada, and upon the international trade of the Dominion. Properly directed, these increased facilities may contribute enormously to the public welfare. But it must be recognized that while industry, geared to war-production, may be temporarily sustained in the postwar period by the backlog of demand for goods in restricted supply during the war, and by the requirements for the rehabilitation of those regions devastated by war, it is imperative that this "sellers" market be recognized as an abnormal one, and that, if a period of recession is to be avoided, adequate planning must be undertaken at once. This planning must be based on research, with a view to the production of new articles to meet new demands, or to the reduction of manufacturing costs with the object of extending the market for existing goods. To limit our "Planning" to such efforts as the restriction of output, whether by limiting the scale of effort or by shortening the hours of labor, with a view to spreading over a longer period the production necessary to meet existing demand, will merely add to the ever-present danger of inflation. Goods must flow as rapidly as possible from the production line, and, while the peak demand is being met, plans must be made for the adjustment from a period of abnormal markets to the more stable conditions of normal times.

### Reasons for Lack of Research in Industry

It seems quite likely that a considerable portion of Canadian industry lacks any appreciation of what research might mean to it. This is not remarkable. The superficial enthusiasm for research immediately after the World War I, based on inadequate understanding, led to its use chiefly as "advertising copy", with the result that many industries obtained a completely misleading concept of the value of research. Moreover, since many of our industries are subsidiaries of companies in the United States, they have been content to leave to the parent company the solution of technological difficulties and the discovery of new marketable products. Further, although it was demonstrated during the war that Canadian industry could produce articles exactly to customer specifications, that customer was in a position to make known exact needs, and, in many cases, to provide designs. Such a situation left to industry responsibility for investigation of manufacturing processes only, and failed to emphasize the fact that there was much fundamental research behind the design. In peacetime the articles to be produced must be determined and designed through fundamental and applied research by the industry itself. To accomplish this will require considerable time and considerable investment, but industry, if it is to be successful, cannot afford to await developments. It must bring them about.

To most of our smaller industries—industries which make up more than ninety per cent of the number of industrial establishments in Ontario and which give employment to some fifty per cent of our factory workers—this idea is

	1937	1943
*Establishments.....	9,796	10,587
Employees.....	321,743	570,017
Gross Value of Products.....	\$1,880,388,188	\$4,221,101,063

completely foreign. In these enterprises there is a minimum of trained personnel, scientific or otherwise, who normally provide the stimulus for investigation and development. Too often, probably because of their origin, these companies scoff at the so-called "scientific approach," and rely completely on empirical methods, with the result that many of them employ obsolete techniques. These may mean not only higher costs but a product of inferior quality and there can be but one ultimate outcome of such a situation—the failure of the business.

An extension at the provincial level of the present Technical Information Service of the Department of Reconstruction, perhaps through the Ontario Research Foundation, would be a step in the right direction.

### **Government Interest in Research**

Nor can the Government in times of peace be expected to assume complete responsibility for industrial research. It is true that the social and economic implications are of such magnitude that the Government has a vital interest in industrial welfare and should make every effort to guard against industrial collapse. But its efforts should be those of an assistant—an assistant urging and helping industry to widen its horizons, that there may be suitable outlets for the tremendously increased capacities for production. Unless these outlets are found the results may be catastrophic. Though this should be mainly the responsibility of the individual industries a certain amount of government assistance generally applied would help to co-ordinate the efforts of industry.

### **General Factors to be Remembered**

In plans for any programme of industrial research two limitations must be borne in mind—the limitation of time and the limitation of funds. Our most likely industrial competitors, United States and Great Britain, are intensively active in research matters, while Russia, a potential competitor, is expending probably more in money and in effort than either of the others. These countries are recognizing, too, that there must be intimate co-ordination of effort and mutual stimulus by industry and agencies for fundamental research. It might well be that the effort being put forth in these countries will, if we delay, cause us to be hopelessly outdistanced in the staking of claims on the new industrial frontier.

Although we are, as yet, at no disadvantage in the matter of time, the same fortunate situation does not prevail in the matter of funds. We never can hope to match, in total expenditure and probably in per capita expenditure, the amounts which will be available for research in the United States, Great Britain and Russia. But the measure of total or per capita expenditure is not necessarily the measure of success. Quality of research can compensate for the disadvantages of less extensive investigations. There is every reason to believe that our scientific personnel is as competent as any group in the world, and that our industries are as adaptable as those of other countries. The prime necessity, it is apparent, is the judicious use of the talents and the facilities that are ours. The harnessing of those talents and facilities, through a co-ordinated research programme, was eminently successful during the war. They can be used just as effectively, surely, for purposes of peace.

### **Difficulties**

The problem of proper co-ordination and extension of industrial research is not an easy one. The general apathy referred to previously is reflected in the



inadequate research machinery at present in existence. It is true that many of the larger industries do operate research laboratories, and, in certain fields, there are commendable facilities. But, by and large, probably industry is concerned less with widening its scope and its abilities than it is with filling orders, trusting to a competent sales staff, to newspaper and radio advertising, and to courtesy and service for the maintenance of markets for its products.

There are, in Canada, no laboratories comparable to those of the DuPont, General Electric and the Standard Oil Development Company, and it seems unlikely that there ever will be, for reasons which are obvious. We have no extensive semi-public applied-science research laboratories, such as the Massachusetts Institute of Technology, the California Institute of Technology, the Carnegie Foundation, nor Research Stations such as those for aeronautical research at Langley Field and Moffett Field. Nor are our aircraft industries able to support research laboratories on the scale found necessary by the aeronautical industries in the United States. It would seem that, since our industrial operations are on a scale which makes private research in certain fields impossible, the responsibility for these large scale investigations must, of necessity, be assumed by the Government.\*

It should be remembered, too, that a considerable proportion of our industrial productive capacity is in units so small that the maintenance of their own research laboratories is quite impossible. While the larger industries will probably, to a greater and greater extent, make provision for some research, the problem of the small industry will remain. The need for government help in the field of agriculture has long been recognized, and there would seem to be every reason why similar services should be extended to small industry. Great Britain recognized this during World War I, and gave financial help and encouragement to Research Associations, the aim of which was to provide co-operative research facilities to the various competing companies in a particular field. Twenty-eight of these associations have been formed, or are in the process of being formed, and while the financial support they have received from members leaves much to be desired, and while they have been no panacea for production and marketing problems, they have rendered considerable service.

Some of the industrial groups in Ontario and in Canada are discussing just now the possibility of co-operative action. Though many are loath to work together at the research level for competitive reasons, and because they fear the domination of government bureaus, there are some who will work co-operatively and with a government sponsored group as well. An example is to be found in the textile industry, and in this industry, at least one medium of approach would be through the Textile Division of the Ontario Research Foundation.

Another difficulty is that of the personnel. Lately there has been a pronounced tendency on the part of those companies aware of the possibilities of research to entice scientific personnel from the universities. While this may answer an immediate industrial need, it may well have unfavourable repercussions over a period of time. The universities still are the major training ground for scientific workers, and if the instructors are enticed from the university laboratories, the quantity and quality of instruction given may suffer considerably. The inducements offered by private interests are many, and this coupled with those from other countries, may easily promote a critical shortage of teachers within our universities. Industry must appreciate this fact, if it is to be provided

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\*See C. J. Mackenzie—Research in Canada—Page 38.



with a steady supply of competent scientists. It should be possible to evaluate the need for instructors and for industrial research personnel in the light of long-term requirements of industry itself.

Still another difficulty is that arising out of the question of patents. Those engaged in fundamental research are averse to restricting discussion of the problem at hand to a few persons, and research leading to post-graduate degrees may require publication of results. For that reason private companies have hesitated to finance research in universities. More recently that attitude has been modified, and, when required, arrangements have been made to meet special conditions. Discoveries within the university, arising out of research financed by public funds, present further patent difficulties, as the university may not wish to patent the idea and private interests may do so. The weakness here seems to be the lack of an organization such as the Research Corporation in the United States. This organization, described as "an engineering foundation organized to transact business for the advancement of science, to which profits are applied," takes over and patents discoveries made in the laboratories of universities and technical institutes. The profits from the sale of patent rights are applied to grants in aid of research to be carried out in such institutions. The scheme has been quite successful, and there are now several such foundations in operation.

## Recommendations

Recognizing the urgency of the situation, and in spite of the limitations in the matter of funds, the paucity of machinery for research, the apathetic attitude of a considerable portion of industry, and the fact that information on the subject is quite inadequate, the Commission feels that a start on a co-ordinated programme of industrial research can and must be made, and respectfully submits for consideration the following recommendations:—

### 1. The immediate institution of a campaign designed—

- (a) to stimulate the interest of industrial management in research,
- (b) to encourage the use of the library service of the National Research Council,
- (c) to extend the use of the facilities of the Technical Information Service, of the Research and Development Branch, Department of Reconstruction and Supply, by direct action in Ontario through the Ontario Research Foundation,
- (d) to arrange for more direct extension of research results to industry on a basis of free assistance for a trial period developing through a part pay period to a point where the research effort in industry would be mainly supported by the industry.

2. The encouragement of industry to take advantage of existing taxation benefits for research and the investigation of the possibility of obtaining further concessions in the matter of taxation of industries, with a view to encouraging expenditures for research.

3. Investigation of the advisability and practicability of the formation of Industrial Research Associations for co-operative research, and of granting some financial assistance to such associations, if any are formed, with the definite

understanding that these organizations are to be managed and maintained by the interested industry.

4. Endorsation of the suggested extension of the National Research Council Laboratories, the Ontario Research Foundation, and other such laboratories, to include facilities for research, both fundamental and applied, beyond the financial means of Canadian industrial institutions.\*

5. The establishment of a patent-holding organization similar to the Research Foundation in the United States, to patent discoveries made by universities, research associations, etc., with the profits to be applied to further research and extension work in and by such institutions.\*\*

6. The formation of an Advisory Committee, or Committees, representing Industry (preferably through some such agencies as co-operative Research Associations) to make known to the Ontario Research Commission the needs of industry.

7. That the Ontario Research Foundation be provided with such funds that are necessary to secure the additional space and personnel to—

- (a) Give the necessary leadership in organization to promote the foregoing six recommendations.
- (b) To secure qualified personnel to diagnose the problems of individual manufacturers and to direct them to the best places for aid in each particular case.
- (c) To make possible fundamental research for trade groups; such research to be paid for in the main by such groups but supplemented by the government on an agreed percentage basis.
- (d) To assist individual manufacturers to promote research either within the Foundation or within their own facilities, or to assist individual manufacturers by giving guidance in the setting up of facilities for testing, control, and minor investigational work—with or without government financial aid.
- (e) To act in conjunction with Industrial Canada in the promotion of a continuous and persistent stream of research ideas to the Ontario members of the Canadian Manufacturers' Association to the end that all members will eventually become research-conscious, and interested in a review of their own manufacturing position.
- (f) To encourage and to assist where possible (or to advise where assistance can be secured), individual manufacturers to bring about simplification and improvement in the efficiency of methods of production and the streamlining of their manufacturing operations.

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\*See further—C. J. Mackenzie—"Government Sponsored Research" in *Research in Canada*, page 37.

\*\*See further—Problems of Scientific and Industrial Research, A Statement—Nuffield College, page 60.

**MEMORANDUM ON INDUSTRIAL RESEARCH SUBMITTED  
BY CANADIAN MANUFACTURERS' ASSOCIATION**

December 6th, 1946.

The Chairman and Members,  
Ontario Research Commission,  
47 Queen's Park,  
Toronto, Ontario.

Gentlemen:—

The Ontario Division of the Canadian Manufacturers' Association, which embraces within its membership some 2,700 manufacturers, welcomed the appointment of the Ontario Research Commission by Order-in-Council in August 1945. It noted further that the qualifications of the Commissioners appointed thereunder insured a thorough and comprehensive investigation into the matters specified in the terms of reference of the Commission. The Association has learned that the Commission will shortly be making recommendations concerning its work and desires to submit some observations on the application of technical and industrial research, with particular reference to the Ontario Research Foundation and industry in the Province of Ontario.

The Canadian Manufacturers' Association has always fully recognized the value and necessity of research for the development of industry and has made a valuable contribution towards its encouragement. Its interest was particularly marked during the first world war. It may be of interest to the Commission to record that in February, 1923, the Association arranged a conference at Ottawa to survey the work which had been done on research and to receive suggestions in regard to what might be done in the future. This conference was attended by representatives of the Dominion Government, of leading universities throughout Canada, of agriculture, and of private research organizations, as well as by members of the Association. The valuable information collected at this conference was later published and distributed by the Association.

In order to continue the work done by the Association in regard to industrial and scientific research, the Executive Committee appointed a special Committee in September, 1923.

This action by the Association, and similar action by other interested bodies, revived interest in research at a time when it had declined greatly, and, finally, the Research Council Act was passed in 1924 under which the Dominion Government Honorary Advisory Council for Scientific and Industrial Research was constituted a separate body with corporate powers under the name of the National Research Council. Under the Act, the Council was empowered to make researches with the object of improving the technical processes used in the industries of Canada, and to discover processes and methods which would promote the extension of existing, and the development of new, industries.

In line with its educational programme, the Association held conferences on industrial and scientific research at its Annual General Meetings in 1945 and 1946. These attracted a great deal of interest and many excellent contributions were made to the subject by leaders in this field and in the discussions which took place. It may be of interest to note that while at the 1945 conference some of the speakers were from United States companies, all those taking part in the programme at the 1946 conference were representatives from Canadian Government departments, Canadian universities, Canadian research institutions and



Canadian manufacturing companies. The proceedings at these conferences were fully recorded and widely distributed throughout Canada, the United Kingdom, the United States and other Empire and foreign countries.

In the summer of 1945 it was decided to inventory research facilities in Canadian plants, and to this end information was sought by the Association from its membership across Canada. The results were highly informative and interesting. Of the 577 manufacturing firms replying to the questionnaire, 402 reported that they maintained laboratories for the creation of new products and techniques, improvement of existing products, product and quality control and testing, and that over 3000 persons were engaged in work in connection with them. Many firms also indicated that they used the facilities of government institutions or private laboratories. It is also a matter of interest to record manufacturers spent almost two and a half times as much money on research in 1944 as they did in 1938.

The Association also took a leading part in the establishment of the Ontario Research Foundation, and as the Commission is aware, industry shared with the government of the Province in the endowment upon which the capital structure of the Foundation rests. In the eighteen years that the Foundation has been in operation, it has made valuable and extensive contributions to the scientific knowledge not only of the Province but of Canada. Its annual reports reflect the measure of its work and the high quality of the goods produced in this Province can be attributed in considerable measure to the careful research work which has gone on within its walls.

The governing body of the Foundation in its formative stages laid down a programme which was designed to cover a very wide field of research for the benefit not only of industry but in the broader fields of agriculture, pathology and biochemistry. This programme was under way when the business recession of the 30's overtook the country. The Foundation, like every other institution, felt the effects of this. Retrenchment and financial conservation was the order of the day. Some of the long-term projects which, in many cases involved substantial expenditures, were curtailed or abandoned. Other projects which had been completed were not renewed and this retraction extended even to the short-term investigations which were being carried out for a large number of industries.

These policies, however, were not adopted by all. Many industries continued to take a long-range view on research, foreseeing that its value in respect of the improved quality and lowered costs of their products would be justified when the expected recovery took place. It is hardly necessary to state that these industries reaped the reward of their perseverance. It is also gratifying to record that practically all those industries which had undertaken to share in the endowment, continued their payments into the fund during these years.

It is a matter of record that, during this period the Foundation did not restrict its usefulness. On the contrary, it pursued with closer attention the technological problems which arose as the result of this period of industrial stocktaking and broadened the scope of its fundamental research into those fields not directly allied to industrial research but which were specifically designated in the original programme as requiring investigation.



Following this period of recession and in the period before and during the war, industry underwent significant changes. During this time considerable expansion occurred in the industrial field, notably in the establishment of numbers of smaller industries. It was also significant that this period saw a newer generation of management taking over the direction of many industries. It is, therefore, perhaps not surprising that, preoccupied as it was with its immediate problems, this body of industry under this newer management does not have the close relationship with the Foundation which the industries with which it was associated in its early years, enjoyed.

There has been some divergence in the paths followed by the Foundation and this body of industry to which we have referred. No criticism of the Foundation is intended in referring to this situation. The Foundation is an established institution, equipped and prepared to assist industry and to carry on work in many fields and it has not counted amongst its functions the work of bringing itself continually to the attention of those who might profit from the utilization of its services.

Nevertheless, this gap between the Foundation and a considerable body of manufacturers, particularly the smaller manufacturers, exists today, and the Ontario Division respectfully submits that the Commission include in its investigations ways and means by which this gap may be closed and the Foundation and the industries which it was designated to serve, restored in greater measure to their original relationship.

The Ontario Division of the Association views this situation with some concern and it was with the object of considering what steps might be taken towards assisting to correct this that, during the summer, it appointed a special Committee to investigate the matter and to bring forward proposals which it is hoped would, if acceptable to the Foundation and to industry, result in a resumption of the original programme intended.

Discussions and conferences have been held with Officers of the Foundation in the past few weeks and it would appear, at this stage, that initial steps towards the development of a programme designed to bring the Foundation and industry in closer alignment, might be considered through three lines of approach. These are:

- (a) A programme conducted by the Foundation and designed to bring the work and facilities of the Foundation to the attention of manufacturers in the Province, and in particular to the smaller manufacturers.
- (b) Further exploration by the Foundation of the possibilities of bringing groups of industries having common problems into a closer relationship with the Foundation for the purpose of solving these problems on a basis of mutual benefit.
- (c) The encouragement of organizations of scientific and productive personnel within broad groups of industries, particularly those maintaining research facilities of their own, for the interchange of ideas and information which would help them in their work.

In the foregoing the Ontario Division of the Association would be prepared to co-operate as far as possible.

If the suggestions given above were completely developed expansion of the Foundation would be necessary, and as these suggestions are considered as part of an even greater programme of endeavour in the realm of industrial and scientific research, the Association considers, therefore, that it would be necessary for the Foundation to adjust its facilities to take care of the expansion which would result from such a programme.

In the past the Foundation has at all times been allowed to conduct its scientific work as an independent organization beyond the sphere of governmental jurisdiction. By reason of the peculiar nature of scientific work, this has undoubtedly been a fortunate policy in which the Association strongly concurs. It is urged that no measure be considered that would interfere with this independence, as such circumstances are all-important to the performance of a high standard of scientific work. However, the Association believes that the government can, without departing from this principle, perform a useful function by providing material assistance as required to the Foundation to be devoted primarily towards investigations and research into problems, the solution of which will benefit industry as a whole and in addition will enable the Foundation to develop a continuing programme of publicity designed to inform industry of the potentialities of industrial research and the facilities which exist in the Foundation for this purpose.

The Ontario Division of the Association would, in conclusion, remind the Commission that the Board of Governors of the Foundation includes representatives of a number of branches of Ontario industry, as well as of science, and urges that whatever measures the Board intends to advance towards broadening the services of the Foundation, be favourably considered by the Commission as a contribution not only to the industrial community but to agriculture, the forests and mines, and educational institutions of the Province, and thus to the ultimate benefit of all its citizens.

THOS. E. BOYCE, Chairman,

Ontario Division,

Canadian Manufacturers' Association.

## THE ONTARIO RESEARCH FOUNDATION

The following is a brief presented to the Ontario Research Commission on September 18th, 1946, by the Executive Committee of the Board of the Ontario Research Foundation.

### Statement by Mr. E. G. Baker, Vice-Chairman

The Board of the Foundation which I represent is grateful for the opportunity given to us of speaking to this Commission about our work. We feel that the great majority of industrialists have an increasing realization of the contribution which applied science has made and must make to the solution of the many problems which confront them today. What is generally accepted in the atmosphere of the large industrial unit is equally applicable in the case of the many thousands of smaller plants scattered all over this Province. Similar methods must be employed more and more if we are to use wisely the basic raw materials and agricultural products of Ontario. The problem is how to make available to Industry and the Government the facilities for research which they require. We have endeavoured to face up to these problems in the past and have made a distinct contribution to industrial development which is far in excess of the expenditure involved. The opportunity before us now is much greater, and we welcome the privilege of outlining to the Commission our plans and our immediate requirements. May I assure you that up to the very limit of our own available resources we shall press forward and try to equip the Foundation with good men and the necessary equipment. At the present time we are enlarging our laboratory building. Steps are being taken to secure additional leaders in special fields of research. It is with strong conviction that we ask this Commission to recommend certain items to the Government. The need and the opportunity are before us, and it is on the basis of our past record and the increasing demand for our services that we respectfully ask for your support. I would ask Dr. Speakman, Director of the Foundation, to address you and present in greater detail the views which I have endeavoured to express.

### Statement by Dr. H. B. Speakman, Director

The Ontario Research Foundation was established by provincial statute in the year 1928. It was the outcome of a movement which started among both industrialists and scientists during the first world war. The problems of manufacturing, shortages of essential materials and the lack of trained personnel left in their minds the thought, "Why should Canada be so dependent on other countries for applied research facilities?" I would couple with this the feelings and thoughts of men, who like myself were engaged in university work, as we watched and assisted the steady stream of good men, trained for research, crossing the boundary to find work and to contribute immeasurably to the economic and intellectual life of our neighbour. As a result strong representations were made from time to time to the Government by the organizations of manufacturers, by the Royal Canadian Institute and other scientific bodies that steps should be taken to establish suitable laboratories in this province.

In 1927, the Premier of the Province, the late Hon. C. Howard Ferguson, took the necessary steps to bring this about, and in the following year introduced the Bill which I have mentioned. The objects of the Foundation were defined in broad terms and the Government asked for authorization to contribute a sum of one million dollars to the Foundation, provided a similar sum was raised



from institutions and private sources. Later the Bill was amended to allow this sum to be exceeded owing to the fact that approximately \$1,600,000 was promised, and in the subsequent 5-year period over 90 per cent of this amount paid by the original subscribers. The Bill was passed with the unanimous consent of the Legislature.

The Government in addition placed at our disposal a house on the crescent of Queen's Park and subsequently made the adjacent house available. In 1929 steps were taken to erect the lower portion of a fire-proof and properly designed laboratory building to which the Foundation is now adding two floors. The present Government has vested in the Foundation the title of both the land and buildings.

In 1944, the present Government of the Province introduced a new Bill which changed slightly the administrative detail, and it is now possible to describe the Foundation as a Board appointed by the Lieutenant-Governor in Council to administer a trust created by the Government and private subscribers for the furtherance of applied scientific research in this Province.

The objects of the Foundation as defined in this Bill are as follows:

- (a) The conservation, development and utilization of the natural resources of the Province;
- (b) the development and utilization of the by-products of any processes involving the treating or using of the mineral, timber or other resources of the Province;
- (c) the development and improvement of methods in the agricultural industry and the betterment, welfare and progress of farm life;
- (d) the mitigation and abolition of disease in animal or vegetable life and the control and destruction of insect or parasitic pests; and
- (e) the improvement and development of industrial materials, products and techniques.

It will be clear to members of the Commission that no institution starting from scratch and with comparatively meagre resources could be expected to cover such a large field of both science and technology. May I state in brief form one or two of the principles of policy which guided the Foundation in the early days:

(1) We asked ourselves what work was being done already and endeavoured to establish and maintain contact with other institutions, notably the National Research Council and Departments of Government, in order to avoid unnecessary duplication of effort. You will observe that I say, unnecessary, because I sometimes wonder whether it is sufficiently realized that confirmation of scientific work and even a certain amount of healthy competition are good for all concerned. For reasons which I need not enlarge upon we left alone the electrical field, medical problems, the petroleum industry and the production problems of agriculture. We endeavoured to supply the needs of basic industries such as metallurgical, food and textiles.

(2) The basis of our organization was and is a small group of senior and competent men with research ability and a technical knowledge of some special field. May I say with confidence and in the light of their accomplishments that in Dr. Ellis, Dr. Westman, Dr. Goodings and Dr. Marshall we have a team which

conforms with this fundamental requirement. They all left good positions, many of them in the United States, to return to Canada and to engage in work which they enjoy and which appeals to their sense of loyalty and obligation. In speaking of them I am referring to the very core and essence of this or any other research organization. All other considerations are of secondary importance.

(3) The objectives outlined in the Bill clearly indicate the dual function of the Foundation. In the first place it is assumed that we are to be responsible for the investigation of certain basic problems of interest to the people of the Province as a whole. Secondly, we are to co-operate with and assist industrialists in the solution of their special problems. In the one case our client is the Government and in the second a group or a single manufacturer. It was the intention and it has been the consistent policy of the Foundation to ask both clients to pay for the work done.

This policy, and speaking now with particular reference to the Province as a whole, was accepted and continued in operation for approximately 6 years. During this period we carried out investigations relating to contagious abortion in cattle, the lignite deposit in Northern Ontario and the low-grade iron ores of the Province. In every case a splendid contribution was made to the scientific and economic aspects of these basic problems. The lignite report is as authoritative now as the day it was written, and it illustrates the great value sometimes to both Governments and private individuals of a negative report. In the field of contagious abortion my colleagues not only made a contribution to the scientific side, but what was of even greater importance, they demonstrated for the first time that a typical area of Southern Ontario could be freed from this menace to the dairy farmers of the world by working in co-operation with a group of average "dirt" farmers. They did most of the work and carried cheerfully the initial losses which were associated with the elimination of reactors from their herds.

Later in this statement I shall have more to say about the iron ore investigation.

Each of these major problems was undertaken at the request of the Government and in all cases we worked with the fullest co-operation of officers of the Departments concerned. For reasons which I need not discuss the policy of the Government changed in 1934 and their financial support of approximately \$30,000 per annum ceased. We continued, however, to render a service of this character by maintaining a small unit in pathology and parasitology and in physiography. May I ask your permission to return to these later.

During the early years the industrial research field, supported by industry, was profoundly influenced by events occurring in the autumn of 1929. Confidence and enthusiasm for research gave place to acute anxiety and for several years the world-wide depression exerted its influence. Not only individual companies but groups of manufacturers changed their plans and terminated projects which had started in our laboratories. Looking back now it is possible to state that this experience was for us not free from blessings. The institution did not expand in the way which had been contemplated, but we were able to grow I believe on sound lines and in the light of experience, not excluding the results of mistakes. In addition, and of far greater importance, the men we had secured were enabled to concentrate for several years on internal research and to open up fields which have produced a harvest in these later years. May

I call your attention to the list of published papers attached to the annual reports of the Foundation. To-day that work is the basis for much of our contribution to industry in our Fellowship laboratories.

May I say a few words about the war period. Our contribution commenced before the declaration of war in September 1939. We had been at work, quietly and without publicity, developing in co-operation with a group of manufacturers first of all the basic steels required and later a weapon which played an important part in the war. In the early months of the war the Inspector General visited us and found a nucleus of trained and keen men who were glad to co-operate and create with commendable speed the necessary facilities for testing gauges and other essential war supplies. In addition there is the story of assistance rendered to private corporations confronted with new products and processes and demanding standards of the highest efficiency. May I say with confidence that the period 1939-1946 is sufficient and ample justification for the steps taken in 1928. The Foundation proved its worth when called upon.

So much for the past, what about the present and future? With the return of peace we find ourselves under great pressure. There is a demand for research which is taxing to the limit our available space and taxing beyond the limit the resources of a small group of senior men. Our service to industry is of two types, the long and short term investigation, and only in exceptional cases are we concerned with routine analyses or tests. At the present time we have 18 major projects sponsored by Companies. A Research Fellowship involving one or more competent graduates with technical assistants is established and the unit as a whole placed under the supervision of one or a group of my senior colleagues. With each Fellowship there is associated an advisory committee which includes representatives of the organization sponsoring the investigation. In one case the company is spending alone an amount equal to our external revenue for research in the early years. More Fellowships are in prospect as space and suitable men become available. I feel that it is unnecessary for me to stress the importance of this work. Personally I attach equal importance to the short-term work. It is the one way in which we can render positive assistance to the smaller manufacturer, and several hundred are making use of the opportunity. The problems cover a wide field of both science and technology and the work can only be done under the guidance of trained and experienced men. The returns to the firms are in many cases out of all proportion to the sums of money involved. You may ask, "Why is this short-term work not done within the industrial units concerned?" My answer is clear and I believe it to be sound. A small industrial unit can and should equip itself to take care of routine testing and control work. It cannot equip a research laboratory with either the specialized equipment or personnel required. Progress will come if such units can be persuaded to employ a suitable trained person whose main functions will be to formulate the problems as they arise and establish and maintain contact with laboratories, both public and private, where the required information or research service can be secured. May I interject an observation at this point. There is a tendency to emphasize the competitive aspects of business and secrecy and to overlook the amount of co-operative effort including a readiness to pool knowledge and experience gained in privately-owned laboratories. The gap in the desired chain of events is more often than not the man to secure and apply knowledge which is available.

These two types of service to industry will be maintained and developed to the limit of our available resources. We hope to strengthen particularly our



senior staff and to put new life into internal, fundamental research. As a proof of this determination my Board has authorized the extension of our main building. We are, however, confronted with a picture with three aspects: (a) the demand the opportunity are greater, (b) costs are rising and have almost doubled since 1938, (c) our own revenue is gradually falling due to the change in interest rates. To meet the need we have approximately one-half of the fundamental research power we possessed in 1938. Do I need to enlarge on the need for having more than one senior man to supervise and inspire research in the whole field of textiles? This is one example.

In order to assist the Foundation to discharge its responsibilities and its dual function which I have discussed briefly, the executive has authorized me to present to the Ontario Research Commission for your consideration and approval the following recommendations:

- (a) The Government to be responsible for the amount required to carry on two major fields of research which we have initiated and supported for over fifteen years in the general interest of the Province, namely parasitology and physiography.
- (b) The Government to authorize and support additional research projects which are basic to our provincial economy and associated with the development of Ontario's natural resources.

### **Parasitology**

Our activities in Parasitology are all that remain from the extensive biological programme which the Government supported during the early years of the Foundation. This work is altogether in the public interest and is not a revenue-producing enterprise.

In recent years the work has been concentrated on the blood parasites of Ruffed Grouse with a view to a better understanding of the cyclical fluctuations which occur in the population of this important game bird. Of five blood parasites that occur in grouse, two have been found to be of major pathological importance and latterly the investigation has been confined to these, although recently expanded slightly in personnel in order to make more rapid progress. An entomologist is being supported during his graduate training in the University of Toronto, and this summer we maintained a small field party in Algonquin Park studying both birds and insects. It was a productive effort and has provided problems and material for our winter work.

This investigation has been conducted with the full approbation of those interested in wild life. It is duplicated by no other organization. Our parasitologist acts also as part-time lecturer in Parasitology at the University of Toronto and we know of no other specialist in this field in the Toronto area. His services are called upon by hospitals and also by government departments responsible for the maintenance of food standards.

### **Physiography**

Since 1935, the Foundation has conducted an annual programme of soil surveys which has covered all of the agricultural areas of Southern Ontario. All the main soil types have been identified and mapped and related to such factors as topographic form, geological origin, depth to bedrock, etc. Prior to the undertaking of this work there was no available systematic knowledge of Ontario soils. The results of this great task will be published in the not distant future.

The materials of this basic study are of interest to many organizations requiring accurate knowledge of our soils, including the Ontario Departments of Agriculture, Highways and Lands and Forests. Requests are being received for similar information concerning sections of Northern Ontario. All parties interested in the work have urged that it be completed and published in a form that will be useful in applied fields and for educational work.

The projects in Parasitology and Physography have been voluntarily carried by the Foundation since 1934, with a portion of the income arising from its invested funds. The Foundation has been happy to conduct them (a) as worthwhile contributions to scientific knowledge, and (b) as a service to the community.

It is now becoming increasingly important that the support of such projects is producing a strain on the Foundation in the light of its obligations to the larger field of industrial research. Reference has already been made to lowered investment income and advanced research costs. These have combined to curtail seriously the volume of independent research which the Foundation is able to conduct. Such research is imperative if the Foundation is to be scientifically strong. It must keep ahead of the demand for industrial services. The importance of these considerations will be evident when it is realized that the majority of the Fellowship Projects now being conducted at the Foundation have been entrusted to it because basic work on the subjects concerned was done in the laboratories during the 1930's. It is no longer financially possible to follow this practice. The ultimate outcome of the existing situation, if allowed to continue, will be that the Foundation's usefulness to the industrial community and its scientific status will alike suffer. A high standard of scientific services cannot long be rendered on a hand-to-mouth basis.

The Foundation is accordingly faced with the alternative of withdrawing with reluctance from the fields of Parasitology and Physiography or obtaining the support of the Province for their continuance. Figures showing the cost of such support are given later in this brief.

## **Industrial Investigations**

Since its establishment in 1928 the industrial activities of the Foundation have been concentrated in the fields of Biochemistry, Chemistry, Metallurgy and Textiles. This has been a natural development, since it is largely in these spheres that opportunities have existed for the assistance of industry. Staff and facilities have accordingly been provided to meet the type of demand that has been met in actual contact with industrial units.

In more recent years it has been apparent that scientific investigation is warranted in certain fields which the Foundation is not now equipped to serve. In certain of these in which the public interest is concerned, the Foundation could by reason of its facilities and experience make a worth-while scientific contribution. It is not able to do so because of its limited resources.

The following instances are typical of the projects which are of first importance in the economy of the Province and in which research is abundantly warranted,

### **1. Industrial Utilitization of Agricultural Products**

Anything which will contribute to the stability of the demand for agricultural products or to the utilization of wasted by-products will make for the betterment

of agricultural prosperity. For many years effective agricultural research has been conducted in Canada in regard to production. We are not abreast of the times with respect to utilization. Some members of the Commission may know something of the development of what has come to be known as Chemurgy in the United States. I refer to one fact only, the establishment of four regional laboratories, each with a Federal grant of one million dollars per annum to investigate the industrial possibilities of agricultural products. With these laboratories we are already in close contact and we should be equipped at least with the manpower and facilities to explore the potentialities of their work in terms of Canadian materials and conditions.

Below are given a number of significant avenues for research activity of this type:

- (a) **INDUSTRIAL CHEMICALS.** Farm products are extensively used in other countries for the production of solvents, protective coatings, acoustic materials, polymers, etc. There is no doubt that effective work in this field would enlarge the market for farm products and provide new industrial materials which could take the place of imported supplies.
- (b) **VEGETABLE OILS.** Experience during and since the war has shown how dependent we are on imported sources of vegetable oil. The Foundation has gained much valuable experience in the oils and fats field which could be usefully and profitably employed in further investigation of the subject.
- (c) **DAIRY BY-PRODUCTS.** Many interesting applications of dairy by-products have been developed recently, especially in the pharmaceutical, food and chemical industries. Whey is still the outstanding example of a material having only a very limited use. Many other products of dairy origin which are now imported could be made here if their technology were better understood.
- (d) **PLASTICS.** Plastics are derived from many basic materials but they are still relatively expensive in relation to the competitive use of metals and wood. The search for a cheap plastic base therefore goes on. Perhaps an agricultural source may provide the solution.

The foregoing are representative phases of useful headings under which research could be profitably pursued on behalf of Ontario. It is not proposed that all should necessarily be undertaken but rather that a beginning should be made on whatever may be regarded, after due consultation, as being of greatest importance.

## 2. Wood Chemistry

Forests are the source of a substantial portion of Ontario's productive enterprise. The utilization of forest resources is attended by considerable waste, a good deal of which should be recovered if only economic methods were known. The potentialities are promising for the development of secondary industries on the basis of such recoveries and this is significant indeed from the viewpoint of the economic and industrial stability of Northern Ontario. If time permitted I would have referred in greater detail to the research facilities of this general character which are available to our competitors in Russia, the United States and Sweden.



The Foundation has gained a volume of scientific knowledge and experience through actual work in this field. It would seem both logical and desirable to use this groundwork as a base for needed extension to our technology.

### 3. Low Grade Ores.

There are in Northern Ontario millions of tons of low grade iron ores which at present cannot compete with imported ores or with limited high-grade Ontario deposits. The economic possibilities of employing this ore in conjunction with low-cost electric power, warrant serious consideration of investigating new approaches to its use.

Research of this kind would naturally entail a working combination of the electrical background of the Hydro-Electric Power Commission and the metallurgical resources of the Foundation. The work could readily be arranged to include the recovery of titanium which occurs with the iron in the deposits mentioned and is rapidly growing in economic importance. Favourable results in this field would likewise have an important bearing on the future economy of the northern part of the Province.

### 4. Mine Safety

We have already received a request from the Commission to undertake an investigation into the causes of corrosion in mine ropes during service, and it will be a privilege to be associated with this important work. My colleagues go further and stress the importance of a clearer understanding of the characteristics of the wire from which rope is made. This foundation is equipped to investigate the effects of stress on the magnetic and electrical properties of wires of various compositions and possessing differing elastic and plastic properties. These two fields of research are essential if we are to make a worth-while contribution to the safety and efficiency factors of the great mining industry of northern Ontario. Our recommendation is that both should be authorized and supported by the Government.

### Cost of Projects

Prosecution of the investigations to which we have referred would entail outlays for (a) Staff, (b) Equipment, and (c) Accommodation and General Expenses. The following is an attempt to approximate such outlays during the first year of operations.

	Parasit- ology	Physio- graphy	Agricultural Products	Wood Chemistry	Iron Ores	Mine Cable
Number of Graduate Person- Required.....	3	3½	2	2	2	2
Number of Laboratory Assit- ants Required.....	1½			2	1	2
Cost of Personnel.....	\$13,000	\$10,400	\$12,000	\$12,000	\$9,000	\$12,000
Outlay for Equipment and Supplies.....	2,000	2,100	2,000	2,000	10,000	2,000
Accommodation and General Expenses.....	7,000	5,000	6,000	6,000	5,000	6,000
	<hr/> \$22,000	<hr/> \$17,000	<hr/> \$20,000	<hr/> \$20,000	<hr/> \$24,000	<hr/> \$20,000
Total of Above Projects.....						\$123,500
Less: Amount Already Paid for Climatology Work.....						2,400
						<hr/> \$121,100

The above figures are for one year only. It would be desirable indeed if government finances could be arranged to provide for research commitments

over a period of years as the researches indicated are all of a type which will require a number of years to complete. In this connection it should be mentioned that in Great Britain the Department of Scientific and Industrial Research provides grants for industrial research which run for four and five years. We hardly need point out to the Ontario Research Commission the difficulty of interesting scientific workers of a high type in long-term projects for which support is not assured beyond one year.

It will be realized that if these proposals are favourably regarded for active investigation during the 1947-1948 fiscal year, time will be required to obtain staff, accommodation and a certain amount of equipment. It is therefore desirable that the Foundation be informed at the earliest possible date as to whether support will be forthcoming for all or part of the proposals. No project authorized by this Commission and the Government will be started or continued without the background of essentials in personnel and facilities. Our interest is in productive research not in the size of our physical equipment or annual expenditure.

## **Conclusion**

It is the ardent hope of the Foundation that the co-operative arrangements which enabled good investigational work to be done for the Government of Ontario in the years 1929-34, may be resumed. The relationships which existed during that period placed the Foundation in a position to conduct government projects under satisfactory conditions which in turn permitted it to give sound value for the public funds expended.

The industrial economy of the Province is clearly becoming increasingly involved in the application of technology to its operations. The demands for scientific assistance are greater even than in wartime and the peak is not yet in sight. Of the institutions which undertake research, the Ontario Research Foundation is ideally fitted to serve the industrial community of the Province. On the basis of its past record and future potentialities, the Foundation is gearing itself to serve a broader field and needs adequate support on that account. As a contribution to industrial research in the key industrial province of the nation, the annual expenditure involved is comparatively small.

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At a later meeting held on November 30th, and at the request of the Commission, the following additional statement was presented by the Foundation.

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## **Extension Service**

The Board of the Ontario Research Foundation is prepared to accept the invitation of the Research Commission to provide facilities for extension work among the industrial units of Ontario, if the following conditions can be met:

(1) We believe that such work to be effective should be undertaken by competent people working adjacent to and in close co-operation with the senior scientific staff on the Foundation.

(2) Neither our present nor immediate future building space can accommodate this unit, and we must ask for the co-operation of this Commission in securing the necessary offices. Immediately to the south of our property the house, known as the White property, is occupied by the Provincial Fire Marshal. For many reasons we feel that this house is ideal for this purpose. Some such property, in our immediate neighbourhood, is definitely vital to the plan.

(3) Without going into detail at this stage we offer the following suggestions in regard to staff. The success of the work will largely depend on the person selected to organize and direct the work. Furthermore, we stress the importance of associating with him two or three competent young men who will spend a considerable portion of their time in establishing and maintaining personal contact with industrial plants. No service of this character without intelligent follow-up can be efficient. My Board is not in a position to give any detailed estimate of what these facilities will cost, but assuming that the property mentioned is made available, they consider that a budget of \$40,000 for the first year's operations should be considered and approved by this Commission and forwarded to the Government.

We would emphasize that any plan of this nature would supplement and not be competitive with the activities of the Federal Departments and the National Research Council.

I would define the objectives of this Department as follows:

- (a) To secure from all available sources pertinent scientific and technical information.
- (b) To correlate the same and to present it in intelligible form.
- (c) To cultivate directly and indirectly interest in scientific method and scientific research.
- (d) The interests of the enquirer must always come first.

**Group Research**

It is generally agreed that applied scientific research cannot be undertaken by the typical smaller manufacturer. Research Associations in England have by groups gone far toward the solution of this problem by supporting laboratory work in their own interest, but with some help from the Government. Generally speaking, in England the Government has paid about one-third of the bill. We believe that here in Ontario an experiment should be conducted to see whether members of the same industry may be associated together in the support of a research programme, whether this be done by independent facilities or in Ontario Research Foundation laboratories. We are willing to work this out on an experimental basis by making a start on a modest scale in an effort to establish the soundness of the principle involved. Past experience has shown that success will depend partly on whether or not the Government is willing to share in the expense involved, particularly in the initial stages. The plan cannot succeed on a "cash and carry" basis. We recommend that a sum of \$25,000 be earmarked for limited amounts of experimental work in this important field, to be used during the calendar year of 1947.

We regard the two projects which we have outlined as essential components of an overall project, namely, a combined effort on the part of Government and industry, working through the Foundation, to assist the smaller industrial units in raising scientific and technical standards throughout the Province. There is a concensus of opinion that an instrument of this type is absolutely essential.

**BUDGET**

Extension Service: 1947-48.....	\$40,000.00
Group Research: 1947-48.....	25,000.00
	<u>\$65,000.00</u>



## COMMITTEE ON SOILS RESEARCH

### Meetings—

Informal.....	Nov. 2nd, 1945—Ontario Research Foundation Library
Joint Meeting with Ontario Research Commission.....	Nov. 14th, 1945—Ontario Research Foundation Library
Advisory Committee.....	Apr. 4th, 1946—Ontario Research Foundation Conference Room
	.....July 3rd, 1946—Faculty Lounge, Ontario Agricultural College
	.....Sept. 23rd, 1946—Horticultural Experimental Station, Vineland

### Committee—

Dr. H. B. Speakman.....	Ontario Research Foundation
Prof. G. H. Ruhnke.....	Ontario Agricultural College
Prof. F. F. Morwick.....	Ontario Agricultural College
Mr. J. Walters.....	Department of Highways
Mr. A. H. Richardson.....	Planning and Development
Mr. R. N. Johnston.....	Lands and Forests
Mr. G. A. Hills.....	Lands and Forests
Prof. D. F. Putnam.....	University of Toronto, Geography Department
Mr. L. J. Chapman.....	Ontario Research Foundation
Prof. R. F. Leggett.....	University of Toronto
Dr. A. Leahey.....	Department of Agriculture, Ottawa
Prof. E. F. Palmer.....	Horticultural Experimental Station, Vineland

## SOILS RESEARCH IN ONTARIO

### Interested Groups

Perhaps in no other field is there a greater need for a co-ordinated long-term programme than in the field of soils. Soils are of vital concern to Agriculture, and that concern is reflected in the activities of the Dominion and Provincial Departments of Agriculture. Soils data are key factors, and are recognized as such, in the work of the Ontario Department of Lands and Forests, the Ontario Department of Planning and Development, and the Ontario Department of Highways. Information on soils is of assistance to the Department of Mines and to those charged with the administration of game and fisheries. The work of the Ontario Research Foundation on Physiography and Climatology would be much more useful in an intelligent land-use programme if correlated with an accurate and complete study of the soils in the Province, while such a study would be of tremendous value to educational groups in the teaching of geography. The importance of soils in the general economy is further evidenced by the recent setting up of the Associate Committee on Soil Physics within the National Research Council.

That each of the interested groups has done valuable work in this field is a matter of record; that there has been little, if any, duplication is rather amazing.

This situation is due, no doubt, to the splendid co-operation which has existed. There is every reason to expect that the various groups would continue the present practice of mutual help and understanding, but, with the growing need for the immediate extension of our knowledge of soils throughout the whole province, there can be no doubt that a programme, planned and carried out by all, would not only meet the needs of each much more rapidly, but would do it at considerable financial saving over a period of years.

The necessity for some planning and direction of proposed research on soils may best be emphasized by a summary of what each of the interested groups has been and is doing, and what each considers must be done. Only a general statement is included here. More complete detail is given in the attached appendices.

### **Dominion Department of Agriculture**

The prominent place that Agriculture has occupied in the economy of the Dominion accounts for the fact that there has been, in comparison with other industries, a continuous and considerable programme of research and development, the latter usually taking the form more generally known as extension work. The Department has done, for some years, work on soil surveys in co-operation with the Ontario Agricultural College. Various stations are maintained throughout the province and at these work with reference to soils and soil fertility is done. It is hoped that, in conjunction with the Ontario Agricultural College, the study of fertility requirements and crop adaptation of various soil types will be developed. The Science Service Division does work of two types—(a) service work in co-operation with the Experimental Farm Service, and (b) purely research undertakings. Soils samples, collected from various parts of the Province, in soils survey projects, are analyzed, and chemical analyses in connection with soil erosion and the use of fertilizers are made. Chemical studies and tests of soils in regard to apple culture are carried on, and included in their research are the studies of soils colloids and their relation to soil fertility, the problems of forest fixation and some investigations of soil organic matter. Methods of determining plant food requirements have been explored and the question of the role of minor elements in soils have been studied. Extension of the work is planned as soon as personnel is available, and there is no doubt that many of the Department's activities would fit into a larger research programme.

### **Ontario Department of Agriculture and the Ontario Agricultural College**

In this report no attempt is made to differentiate between the Ontario Department of Agriculture and the Ontario Agricultural College. Their association is so intimate that they will be treated as one, and any reference to either implies the interest and assistance of the other.

The position occupied by the Ontario Agricultural College in the development of agriculture in the Province and the contributions it has made to that industry are well-known to all. For our purpose it will be sufficient to mention some of its work and plans in the matter of soils, and to stress again the co-operation which has existed between it, the Federal Department of Agriculture, the Ontario Research Foundation, and the other groups interested in soil research. The first claim on the staff of the College is, of course, the responsibility for teaching the students, but they have made and will make singular contributions in the matter of soils. The major project which is commanding the interest of

the College is that of Soils Survey. Many counties have been mapped, and further work along this line will be done as soon as personnel is available. This mapping has been supplemented by considerable laboratory work on the study of soil types, but the College itself feels that there is still a need for chemical and physical investigations of the soils mapped, to provide fundamental information in connection with problems of soil fertility and soil conservation. In addition, a good deal more work on forest fixation, soil colloids and soil fertility should be undertaken.

An extensive programme of co-operative field experiments has been initiated on selected farms where the effects of various fertilizers, the amounts required, and the best method of application, as reflected by crop response, are studied, and these experiments are supplemented by laboratory research. The demonstration plots, at which field meetings are held, are of tremendous value in teaching soil management to farmers.

A Soil Advisory Service is maintained at the College, where each year some four thousand soil samples are tested for farmers and fruit growers. In this connection much useful information is obtained from the questionnaire which the applicant is required to complete. Further limited tests are provided by County agricultural representatives equipped with field kits. At the present time a programme to assist in soil conservation is being developed. The plan is that a farm will be mapped in respect to its soil types, and a complete scheme for the best use of the land and for soil conservation, under a system of cropping and rotation best suited to the needs and potentialities of the farm, will be worked out. The business management of the farm will, of course, be left to the farmer concerned. (See page 46.)

### **Ontario Department of Lands and Forests**

Since this department is concerned with the sale of public lands and the management of forests, it is interested in soils surveys for the purpose of determining (a) the relation between soil type and forest growth, (b) which regions should be opened for agriculture, and (c) which should be maintained as forest or planted to forest. The northern clay belt is the region of major concern at the moment, and accurate soil information is required to prevent the improper assignment of sections of this region for purposes of settlement. On the other hand complete information in regard to soils would enable the Department to undertake an intelligent programme of land reclamation in regions of muskeg and in regions swept by fire. Moreover, since soil fertility is a definite factor in the welfare of fish, it is a matter of concern to those charged with the proper management of our fisheries. (See page 70.)

### **Ontario Department of Planning and Development**

The Conservation Branch of this Department is interested in river valley development which has to do with soil conservation, forestry, erosion, water conservation, flood control, underground water and land-use. The project in the Thames River Valley area, where the land has been classified on the basis of its use capabilities, and the soil types, erosion, and slope have been mapped, is a typical example of what form the work of the Department will take. (See page 54.)

### **Ontario Department of Mines**

In Southern Ontario considerable work has been done on ground water and its relation to the problem of soils. Much remains to be done. The work of



preparing a uniform system of logs to be followed by well drillers is an example of an undertaking which is incomplete.

### **Ontario Department of Highways**

The importance of soils in the matter of highway construction has led to the establishment, within the Department, of a soils division. Its purpose is to provide information as to the soils over and through which the highways will run, with a view to assessing such factors as compaction, the presence of frost-heave material, the depth of the water table below the surface, the type and thickness of the base course required, and the type of materials which should be used in the construction of the road. Consideration of these factors is essential to ensure stable foundations which are obviously necessary for any degree of permanence. County soil maps are used as a preliminary guide for a much more detailed strip map, and the type of classification used is identical with that used by the other groups doing soil survey work. (See page 57.)

### **Ontario Research Foundation**

The initial interest of the Ontario Research Foundation was in crop adaptation, and this led directly into the problems of soils classification and climatic conditions. A vast amount of work on climatology has been done, the value of which would be greatly enhanced by a complete survey of soils. The correlation of climate and soils would make possible a much more reliable basis for proper development of forests and farm lands, and the Foundation is in agreement with the other groups that the most urgent need is the completion of soils surveys throughout the Province. (See pages 59.)

## **ADVISORY COMMITTEE ON SOILS**

It is apparent, then, that there is every opportunity for mutual help and co-ordinated effort on the part of the various groups concerned with the problem of soils. How best this can be promoted, keeping in mind the needs of each, together with their facilities and personnel, remains to be considered. Recommendations to this end are respectfully submitted.

### **Suggested Recommendations**

For Co-ordination and Direction of Soils Research:

- (a) The establishment, on a permanent basis, of a central organization to co-ordinate a general programme of research for the Province, and to advise the Government thereon.
- (b) The establishment, by this organization, of an Advisory Committee on Soils.
  - (1) to submit plans for the co-ordination of all Soils Research in the Province.
  - (2) to submit estimates of the cost of the suggested programme.
  - (3) to correlate the data arising out of this research, for submission to the central organization.
  - (4) to advise the central organization on all matters pertaining to Soils Research, including such considerations as personnel, scholarships and fellowships, publications, etc.

### Projects—General:

- (1) The establishment of more extensive fellowships and scholarships to attract students to the field of Soils, with a view to correcting the present deficiency of qualified personnel in this field.
- (2) Renewal and extension of the programme of Soils survey, with a view to the complete mapping of the Province at the earliest date possible, and recognizing the particular urgency of the study of the soils in the northern clay belt.
- (3) Assistance to permit an expansion of activities in the fields of Climatology and Physiography, and the correlation of existing data in these studies with the data obtained in Soils Surveys.
- (4) The expansion of the programme of the mapping and land-use direction of individual farms.
- (5) The encouragement of the co-operative study of fertility requirements and crop adaptation of various soil types.
- (6) Extension of the work on forest fixation, soils colloids and soil fertility.
- (7) Extension and encouragement of the work of river-valley development.
- (8) Provision for the inauguration of a programme of waste-land reclamation and forest regeneration based on accurate information regarding the soils in the areas concerned.

### Projects—Special:

The projects listed below have been selected because they involve fundamental problems bearing upon ultimate land use, and because, at the present time, no systematic large-scale work is being done on any one of them.

Some of these projects offer an excellent medium for co-operative research on the part of two or more institutions or departments, and can be broken down readily into sub-projects suitable for post-graduate students in several fields.

1. Physico-Chemical properties of Ontario soils affecting the erodability of important soil types.
2. A study of the physical, chemical and mineralogical character of the clays in the major soil types.
3. A study of water-borne sediments and soil nutrients in rivers as a measure of soil erosion losses from a watershed.
4. The rate of infiltration of rainfall into soils as related to run-off.
5. The distribution of cobalt, manganese and iodine in soils and crop plants in relation to the incidence of deficiency diseases in livestock.
6. An investigation of the sulphur content of the precipitation in various localities in relation to sulphur additions to the soil.

# THE DEPARTMENT OF SOILS—ONTARIO AGRICULTURAL COLLEGE

## Professor G. N. Ruhnke—Ontario Agricultural College

The Department of Soils in co-operation with other departments of the Ontario Agricultural College, such as Agronomy, Horticulture, Drainage and Agricultural Engineering, and with the co-operation of the Dominion Experimental Farms Service, proposes to assume the responsibility for dealing with the problems of classification, mapping, utilization, management and conservation of farm soils in the agricultural areas of the Province.

The Department does not propose to initiate surveys or investigations of forest soils problems, of problems of soil mechanics or of problems related to the location or construction of highways, dams, airports, and etc., but will co-operate in providing information from soil surveys or others of its projects, of assistance in dealing with such problems.

The Department of Soils proposes to continue and to develop its programme as follows,—

### 1. Soil Surveys

(a) Complete as rapidly as possible the preparation and publication of maps and reports for the counties surveyed but not yet covered by publications.

(b) Complete as rapidly as possible the classification and mapping of the soils of agricultural areas in the remaining unsurveyed counties in Southern Ontario and in the districts of Northern Ontario.

(c) As soon as the extension to the present Soils Building is completed and additional laboratory facilities are available, the Department proposes to expand its programme of fundamental research in the study of soil types and their characteristics, as they relate to land use, erosion control and soil conservation.

### 2. Soil Fertility Investigations

It is recognized that the maintenance of the organic matter and the fertility of the soil, are basic to other measures for restoring the productivity of run-down or depleted arable lands. These problems involve the type of farming, system of cropping, and the characteristics of the soil type.

By means of correlated laboratory studies, pot cultures, and field experiments, it is proposed to continue and expand the investigations of the use of lime, fertilizers, manures, crop residues and other soil amendments for fertility maintenance and crop production.

### 3. Individual Farm Surveys for Soil Conservation

The Department is developing a farm planning service for soil conservation, to make individual farm surveys, prepare plans for the farmer, and direct the initiation of the recommended conservation practices on the planned farms.

Until a larger staff of trained personnel is available this service is being concentrated on typical farms selected specifically for demonstration projects, by County Agricultural Committees and the County Agricultural Representatives as a part of the County Soils Programme.



The Agricultural Committee and the Agricultural Representative take the responsibility for selecting the farmer and the farm, where there is assurance that the plan for land-use adjustment and soil conservation practices worked out for the farm will be put into operation without delay. The Committee is expected also to maintain an active interest in the demonstration and give encouragement and assistance to the operator of the farm in carrying out the recommendations. These demonstrations are intended to show how an integrated plan of land-use, soil conservation practices, and good farm management can benefit the farmer and the farm.

As a part of the local educational programme on soils, the County Committees are expected to hold field meetings on these demonstration farms when established, so that other farmers and the public generally may see what is being done in a practical way to promote soil conservation.

It is intended to expand the farm planning service as rapidly as possible, in relation to the demand, so that the service will be available to any farmer who desires it and is interested in undertaking a co-ordinated programme for soil conservation on his farm.

#### **4. Investigation of Erosion on Cropland**

It is proposed to undertake studies of losses of soil and water by run off, on selected sites, having regard for soil type, slope, crop rotation, etc., to provide local data for use in connection with the farm planning service.

#### **5. Training Personnel for Soils Work**

The Department recognizes the serious lack of soil surveyors and other soils specialists at the present time and the urgent call for trained personnel to adequately staff its own organization, as well as those of the other co-operating agencies engaged in soils work in this Province.

To help to meet this need, provision is being made in the new Department for more adequate organization and facilities for graduate instruction and research. Further, it is intended to establish at the earliest possible time, a Soils Option in the third and fourth years of the Degree Course in Agriculture, to give more encouragement to students to proceed to specialize in some phase of Soil Science in post-graduate study.

Technical short courses of instruction for basic training in soil survey and farm planning techniques will be given also, as soon as the present staff of the Soils Department is increased sufficiently to take care of the current programme of teaching, surveys, experimental work and service work, and make possible taking on additional commitments.

# RESEARCH DIVISION—DEPARTMENT OF LANDS AND FORESTS

## R. N. Johnston—Research Division

The soils research programme of the Department of Lands and Forests is determined by the administrative functions of the Department. These are:

1. The sale of public lands.
2. The management of public forests.

The area involved amounts to some hundred million acres south of the Albany River and some fifty million north of this line in the District of Patricia.

Governing factors in this programme are:

- I. (a) A provincial soils inventory and analysis of soil classes on the basis of inherent soil values.

Using this information, the Department can intelligently segregate farm and forest lands on the basis of estimated financial returns.

- (b) Set up forest uses of forest soils which will secure the maximum yield without depletion of soil values.

This will secure settled and permanent conditions in wood using industries.

## II. Short Term Objectives

- (a) The early completion of a soils survey of crown lands adjacent to developing farm communities.

This information is related to a sound postwar settlement scheme and is the Department's priority soils research project.

- (b) The establishment of a soils research laboratory.

Soils laboratory services are required to complete any soils survey. Such a laboratory should be competent to cover the physical, chemical and biological factors of soil value. Detailed knowledge of Ontario's forest soils is practically non-existent.

## III. Proposed Expansion

Perhaps the most important soils problem in the Province is concerned with the Northern Clay Belt bordering James and Hudson Bays. At least 20,000 square miles in this tract are at present covered by a barren muskeg, apparently the result of a degrading combination of climate and drainage.

Properly developed, this blank area, and a tract of poor forest land bordering it of equal or greater extent, could almost certainly be converted to a productive forest area, could probably become good grazing land and might possibly develop suitable conditions for general farming.

The realization of this soils productive capacity along any of the three lines indicated above, or as any combination of them, should have a decided effect on the economy of the Province. If and when funds are available, the Department plans to investigate this problem.

In view of the above, it is, therefore, suggested that:

- (1) The Department will require \$50,000 annually in addition to present expenditures, to carry Items I and II above at maximum speed for the next five-year period.
- (2) An additional \$50,000 should be available for an initial experiment in the improvement of Clay Belt soils. This sum is required to cover one season's field work and studies of results obtained.

Signed: "R. N. JOHNSTON",  
Chief, Division of Research.

pproved: "F. A. MacDOUGALL".

ANNUAL OUTLAY FOR FIVE-YEAR PLAN

Salaries .....	\$27,200 - \$36,200
Travelling Expenses .....	7,000 - 10,900
Maintenance .....	3,000 - 5,000
Publication of Maps and Reports .....	2,000 - 4,000
	<hr/>
	\$39,200 - \$56,100

Initial Outlay

Laboratory and Greenhouse (at Richmond Hill Research Station) .....	\$15,000 - \$30,000
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## GENERAL STATEMENT

### SOILS RESEARCH—DEPARTMENT OF LANDS AND FORESTS

#### G. A. Hills, Department of Lands and Forests

Soil research may be logically discussed under three headings, viz. (a) Inventory, (b) Detailed Analysis and (c) Interpretation. In simple words, soil research consists of finding out what soils there are and where they are, how they are put together, and how they can be used. Inventory involves the classification and mapping of soils and other related natural features of land. Inventory is taken by the soil survey, the physiographic survey, the groundwater survey, the land-use survey, etc. These agencies generally show the distribution pattern of land by use of maps. Then after a type or class is established and mapped, it is studied in detail from as many angles as possible, i.e., by chemical, physical and biological analysis, and by experimentation both under natural conditions and under such controls as are provided by greenhouses, culture chambers, etc. Then all the knowledge obtained during inventory and detailed analysis are put together in such a way that the characteristics of each class may be evaluated in terms of capability for some particular land-use. It is obvious that fundamental research is urgently needed to study soil characteristics regardless of use because it is impossible to anticipate all the relationships between characteristics and use before both have been thoroughly studied. It is, however, also true that in a field so little explored as soils, research must be tied in very closely with use in order that we may begin as soon as possible to solve some of the many pressing problems.

While the Department of Lands and Forests is concerned generally with the wise use of all forests and forest land in the Province, it is charged specifically with the sale of public lands and the management and sale of public forests. This means that the problems are chiefly those concerning Northern Ontario, which comprises over 80% of our land area, but which is "home" for only 10% of our population. It is true that forestry can also play an important part in planning and wise use of Southern Ontario lands, but since these lands are largely privately owned the work of the Department in this area can only be one of education, by giving advice and demonstrations.

What should be done with the crown lands of Northern Ontario? It is true that experience and research in land-use in the south will be of some help with this northern problem. But unless it is recognized that there are great differences in the two environments this will result in corresponding differences in land-use patterns the present confusion, which has arisen largely through a lack of appreciation of this very principle, will not be improved.

Take, for example, the disposition of land in the Greater Clay Belt. Recent reconnaissance surveys have shown that while most of the land may be developed for agricultural purposes, the cost of **clearing** and, in many cases **draining**, removing most of the peaty surface and, in general ameliorating the soil is greater than the individual settler can afford. The result is that in the process of developing a few scattered farming communities, over a million acres have been so man-handled that they are no longer attractive propositions for either agriculture or forestry. In view of this, it would seem that a large proportion of the Greater Clay Belt should, for the immediate future at least, be placed under a stable forestry economy, even though the potentiality of the lands

would indicate that, in time, they will be used for agriculture. There is little in the experience of developing Southern Ontario which will assist in planning an economy which will involve a multiple land-use; one in which forestry will play a leading role and which will provide for a gradual shift from forestry to agriculture as the need arises.

In order to provide a frame-work for the study of such an economy the Research Division of Lands and Forests placed, in 1945, a six-man party in the vicinity of the town of Cochrane to classify the land in areas lying just outside the present settlement but including areas cut over and abandoned by previous settlers. A similar study was made by a three-man party in the Lakehead area during 1944.

While much research is needed to determine ways and means of using the resources of soils and forests of this area to the best advantage, we do know that the proper development of these renewable resources is basic to stabilized settlement in the north. Since we have seen that private ownership of land limits the effectuation of what appears to be the wise use of certain areas in Southern Ontario it would appear advisable to guard against the alienation of large areas in Northern Ontario, which would be thus placed outside the jurisdiction of those conservation measures which could best provide for their proper utilization. This is the reason why, on the basis of reconnaissance surveys, a map has been prepared showing the general area in the Great Clay Belt region where the surface rights should not accompany the mining and mineral rights granted those staking mining claims. This does not mean that there is any desire to withhold land from legitimate use for agriculture, mining, or any other industry. It is merely to ensure that land will not be alienated for the purpose of timber exploitation, speculation, etc., which would interfere with a long term conservation programme. This is a responsibility of the utmost importance.

While the initiation of some form of forest management is urgent for the Clay Belts to assist in the stabilization of settlement there, it is no less important in the infinitely greater areas of poorer forested land belonging to the crown in the remainder of Northern Ontario. In fact, so great is the problem and the area involved, the Department of Lands and Forests is selecting a number of "management areas" upon which to concentrate to a large degree investigation of forest practices. Here, too, soils research is urgently needed.

The Department of Lands and Forests, therefore, requires an inventory of all lands which are or should come within the sphere of a forest economy, regardless of whether they are forested or not at the present time, and irrespective of their agricultural potential. The Department also requires a detailed analysis of the land classes of both settlement and forest management areas. It may appear to be immaterial who prepares the inventory or provides the analytical data as long as it is presented in such a way that it can be interpreted in terms of forest capabilities. Experience has shown, however, that inventory and analysis cannot be made adequately without the most thorough knowledge of the problem. For this reason it is essential that certain types of soil research be conducted within the various departments who have the power either to exploit, or to conserve, this most valuable resource. This does not preclude the possibility that a long-term programme of purely fundamental research might, in addition, be carried on most effectively by a research institution unhampered by immediate demands.

In order that inventory and detailed analytical research in soils be utilized to the best advantage, it is essential that the data obtained in those ways be interpreted so that it can be understood by those who are in any way involved in planning the use of forest lands. For example, the research division is responsible to two other divisions within the department of lands and forests for direction in soil interpretation, namely, The Division of Lands and Recreational Areas and the Division of Timber Management. It might be pointed out here that there has been little mention of the use of soil data in forest management—that is, the art of managing a forest crop, not necessarily in a plantation and hence not truly reforestation in its usual limited sense. The work of interpretation is done largely through integrating all the natural land qualities—soil, climate, etc., to form a land class and presenting this in terms of capability for a particular land-use. Correlated with this is the training of forest engineers, public land inspectors and other officials engaged in the development of a sound forest economy.

## SUMMARY

The Department of Lands and Forests, charged with the sale of public lands and the management of public forests, has three distinct and related interests in soil research. These are inventory, detailed analysis and interpretation.

### **A. Inventory** (the classification and mapping of soils and other features of land)

- I. Inventories (soil surveys) are urgently needed as a basis for intelligent land sales. Post war settlement makes this a priority service at this time if tragic and disastrous mistakes which characterize similar schemes in the past are to be avoided.
- II. Inventory of soils and other characteristics of forest sites are essential to the solution of problems of forest management.

### **B. Detailed Research** (chemical, physical, and biological analysis in the laboratory experimentation in the field greenhouse and culture chamber).

- (1) To obtain further information about the types which have been established and mapped under inventory.
- (2) To conduct fundamental research, for example in soil genesis which is a background for all soil research.
- (3) To investigate further soil and crop relationships with a view to a most comprehensive study of soil improvement, to secure better tree crops or to improve forest soils to the point where they may be fit for agricultural development.

The following examples do not exhaust the field of investigation.

- (1) The amelioration of the poorly drained peat lands of the Northern Clay Belt through various methods of drainage, partial removal of peat, introduction of micro-organisms, fire and mechanical operations.
- (2) The effect of applications of peat and other organic matter upon forest growth.



- (3) The effect of fire on forest soil.
- (4) The role played by bacteria, mycorrhiza, and other beneficial micro-organisms in the nutrition of forest species. NOTE:—In this aspect of soil research many of the forest soil problems are different to those of agricultural problems.
- (5) The effect of applications of fertilizers and amendments to forest species with special application to forest nursery and plantation practices.

### C. Interpretation

- I. Establishment of land-use capability classes and other guides for forest settlement and forest management.
- II. Instruction in the character and use of Ontario's forest lands.

The problems involved in the above outline of Departmental policy are fundamental and lie at the root of any progressive development of the Province as a whole. That this is so needs no laboured proof. The simple fact that less than ten per cent of the population of the Province occupies more than eighty per cent of provincial property should be sufficient. It would manifestly be unfair to claim that soils alone have slowed down the development of these new territories. Many factors have been at work, but certainly soils and soil-use are major, if not controlling, elements.

Nothing here stated is intended to belittle or divert support from the work carried out in old Ontario. Much still remains to be learned about these soils and their better use.

Nevertheless, the fact remains that the Province's overriding soil problems, both in respect to the area involved and to the present state of our knowledge, are in the soils of so-called New or Northern Ontario. It is felt, therefore, that any programme for soils study recommended to the Government of this Province, which does not recognize the urgent need of soil classification and soil research for the largely unknown soils of the northern parts of the Province, would fail to face up to one of the most urgent and potentially one of the most profitable fields of post war soils research.

# A STATEMENT OF LAND USE INVESTIGATIONS CARRIED ON BY THE DEPARTMENT OF PLANNING AND DEVELOPMENT

A. H. Richardson, Department of Planning and Development

## Preamble

The Department of Planning and Development is a Department of the Government for "... formulating plans ... to develop the human and material resources of the Province", but is not intended to be an operating Department or one which will eventually carry out major construction works. One Division of this Department is Conservation, and this Division is charged with carrying out investigations in four fields, namely:

1. Land-use studies.
2. Hydraulic studies as they pertain particularly to the selecting of dam sites and controlling floods.
3. Forest investigations such as the care of existing farm woodlots, reforestation and particularly the rebuilding of wooded areas at the headwaters of streams.
4. Wildlife investigations and the planning for recreational facilities in Southern Ontario.

Besides the chief of the Division, four experts in the above types of work are now employed full time in the Conservation Branch. Assisting these are temporary field groups, the size of which depends on the amount and importance of the work to be done wherever surveys are undertaken.

The activities of the Conservation Branch up to the present have had to do with what we term river valley development, and by this is meant "the wise use of all the natural resources of a river valley for all the people living in that valley, for all time." In carrying out such surveys, the aim is to prepare a report, with necessary plans, which can be supplied to conservation authorities in Southern Ontario if and when such authorities are established under Bill No. 81, known as the Conservation Authorities Act. When such plans have been supplied it is presumed that the work of the Conservation Branch with respect to an individual river valley will cease, except that assistance will be given in interpreting the plans of the report and acting in a supervisory capacity as requested.

It will be seen from the above that the Conservation Branch is, therefore, carrying out the meaning of the name of the Department in planning for such projects, but does not contemplate the carrying on the works of construction to complete this, or to do any of the other types of work covered by the report.

In addition to the main types of work indicated above, the Department has also interested itself in ground water studies and during the past year a geologist was employed during the summer months investigating ground water conditions in Southern Ontario. A report on this will be released by the Department early in the new year.

The Department has also undertaken, with the co-operation of the Dominion Water Board, the establishing of 23 gauging stations on the important rivers in Southern Ontario, and these, together with the stations operated by the Board for its own use, and stations operated by them for the Ontario Hydro-Electric Commission, cover this problem for the important rivers of the Province.

This is a type of work which has not been done in Ontario heretofore on a large scale, and is very essential when planning protective dams or programmes of water control on rivers which have a serious flood problem.

## Land-use Studies

Land-use Studies conducted by the Conservation Branch form a part of the larger programme indicated above in river valley surveys. In this connection it is not the intention of the Department to attempt to conduct a land-use survey of the whole river valley, as the staff employed by the Department is not large enough for this purpose, even though it were desirable to carry out such a programme. The plan is to select a small representative watershed on the river valley in question, and carry out a token or sample land-use survey which it is hoped will be indicative of the type of land-use which could be recommended for other parts of the whole river valley. For example, on the Thames River surveys which were conducted during 1946 at least five dam sites were selected, one of these being on Trout Creek just above the Town of St. Mary's. The area of the watershed above this point is approximately 65 square miles, and this was taken as a sample area as indicated above. The survey done on this area has as its purpose to classify all land primarily for agricultural purposes on the basis of use capabilities and to divide the land which is suitable for cultivation from that which is not. The method used was based on the use capability surveys developed by the United States Department of Agriculture Soil Conservation Service, and the classification of land was based on the following mapable qualities:

- (a) Soil type.
- (b) Slope.
- (c) Erosion.
- (d) Physical obstructions to cultivation, such as excessive stoniness.

The intensity of the survey is indicated by the fact that the average coverage for each pair of field men did not exceed 400 acres per day, or 200 acres per man per day. This degree of detail is essential if the information is to be used for farm planning, the logical end of such work.

It was hoped that in addition to the survey outlined above a few examples of farm planning would be established on this particular watershed so that farmers in the area could see the ultimate purpose in such planning. Unfortunately time did not permit this and, as is well known, the number of men capable of carrying out farm planning is extremely limited in Ontario.

In addition to the Trout Creek Area, another small watershed, namely, the North Branch Creek, comprising some 35 square miles was also surveyed in the same summer.

As indicated above, these two land-use surveys on the small watersheds are all that we contemplate doing in the Thames River Valley because it is our intention that with these surveys as a guide, that after the Conservation Authority is set up, it will ask for assistance in such work from the Ontario Department of Agriculture, or if necessity demands it, that it will set up its own land-use and farm planning division.



It will be readily seen from what has been stated thus far that the Department of Planning and Development has no intention of setting up a soils or land-use surveys division, but will plan to continue to carry out such token surveys because in the preparation of plans for complete river valley development, soils in most cases is the important item. If, in the future, assistance can be obtained from the Department of Agriculture or other agencies to carry out the token surveys, it would be in line with our method of operating to have these older established and better equipped Departments do this work for us. In the meantime, as this is impossible, we feel that it is very necessary in the preparation of plans for river valleys that land use surveys be included.

## **Recommendations**

### **(a) SOIL MAPS**

As soil types form the basis for land-use studies it is not only desirable but axiomatic that soil maps be prepared for those parts of the Province where river valley development surveys are contemplated. Therefore, it is urged that the soil surveys of all of Southern Ontario be completed as soon as possible.

### **(b) USE-CAPABILITY TABLES**

Use-capability tables are also basic for land-use studies, and before these can be prepared it is necessary to carry out investigations into relative fertility levels and tendency to erosion of the major soil types. We further recommend that such tables be prepared as soon as possible.

### **(c) AERIAL PHOTOGRAPHS**

As mapping for land-use is now done entirely with the use of aerial photographs, it is important that such photographs be available where such work is contemplated. As the taking of these photographs depends somewhat on the vagaries of the weather, it would be desirable to have such photographs taken of all of Southern Ontario, so that these would be on hand when requests are received for surveys in any particular area.

# SOIL RESEARCH IN THE DEPARTMENT OF HIGHWAYS

**J. Walter, Department of Highways**

Soil studies were started in 1939 when it became evident that construction and design procedures should be supplemented with basic soil data. Soil consciousness developed due to several factors, some of which may be briefly stated as follows:

- (a) Constantly increasing traffic density and loads.
- (b) Present-day public opinion and transportation needs demand the construction of all weather surfaces during the same year or the year following grading operations. This time interval will not permit natural densification of subgrades and embankments nor subgrade defects to be corrected.
- (c) Modern grade and alignment requirements often involve deep cuts and high fills, which require special treatments.
- (d) Limited funds for rapidly expanding highway systems have caused the officials to construct cheaper types of wearing surfaces. Consequently, greater emphasis has been placed on the bearing capacity of the subgrade to transmit the traffic loads rather than the wearing surfaces.
- (e) Snow removal permits greater frost penetration which in turn causes spring break-ups in certain soil types.

## Soil Classification

Prior to any type of soil classification it is absolutely essential to become thoroughly familiar with the glacial geology of the province. This data is a prerequisite of the highly detailed analysis required in highway construction.

Soil classification is essential in order to sort, compile and record the various characteristics of soils so as to accurately identify soils and to permit practical application of the information obtained. It is proposed to use both the U.S. Bureau of Roads classification, which deals with the physical properties, and the pedological classification as developed by the Department of Agriculture.

The county soil maps as prepared by the Department of Agriculture are used as a preliminary guide for a much more detailed strip map. Precisely the same type of classification is done as that performed by the Department of Agriculture. Using the pedological classification as a basis, typical samples of the various soil types are taken and tested in the laboratory for numerous physical properties, considerable emphasis being placed on soil mechanics. Correlation of the two above mentioned systems of soil classification provides a medium for transferring soil information, construction experience and subgrade behaviour from one area in the province to another.

## Soil Data and Application

A comprehensive soil report is submitted to the design office entailing over 20 design features. To insure stable foundations, the basic requirements are:

- (a) Location of the grade line at least 4 feet above the water table.
- (b) Removal of frost heave material.

- (c) Proper compaction of embankments and subgrades.
- (d) Use of suitable materials.
- (e) Type and thickness of base course required.

The strip map is traced on the road plan while the soil report is used by the design office in preparing the final plans.

During grading operations the soil engineer checks the subgrade for frost heave materials and unstable soils, locates the amount of tile drainage required and checks the suitability of embankments compaction.

### Present Status

Due to lack of personnel during war time, immediate demands for routine supervision and testing of highway materials prevented full time work on soils. Apart from one extensive research project, the soils work has been confined to field observations and basic data and to immediate construction projects. The soils work has also been greatly restricted due to lack of personnel and laboratory facilities. A temporary laboratory has been established at the Lands and Forests Experimental Station at Maple. During the last 9 months, 6 soil engineers and 2 laboratory technicians have been engaged in full time work on soils

### Proposed Program

- (a) Advanced study of glacial geology and pedological classification of soils.
- (b) Extensive study of the physical properties of soils with greatly enlarged laboratory facilities.
- (c) Extensive study of aerial photographs as related to soil classification and an inventory of granular materials.
- (d) Field and laboratory research of pavement behavior with the various soil types.
- (e) Field and laboratory research of aggregates as related to durability and field performance of the various pavement types.
- (f) Soil surveys of several hundred miles of highway.

The achievement of this program within a reasonable length of time depends primarily on the following:

- (a) **Personnel**—Since trained soil engineers are not available and a suitable soils course is non-existent, prospective engineers must be trained by this Branch and by periodic consultation with the Ontario Research Foundation and the Soils Department of O.A.C. An additional 10 soils engineers will be required for next year's work. Ultimately it is proposed to have 3 soil engineers stationed at Toronto to supervise the work of 19 field soil engineers and several laboratory soil technicians.
- (b) **Data**—Fortunately the data on glacial geology for southern Ontario has just been completed by the Ontario Research Foundation. This information will be of indispensable value to the Soils Branch.

Although a large number of counties have been mapped by the Department of Agriculture, an early completion of this work, together with soil reports is urgently required. Until all counties have been mapped and the data compiled, continued consultation is quite desirable.

The services of Messrs. Chapman and Morwick have been most generously rendered during the past year and it is hoped that the same splendid co-operation will be secured in the future.



# REVIEW OF RESEARCH PROGRAM IN PHYSIOGRAPHY OF THE ONTARIO RESEARCH FOUNDATION

D. F. Putnam—University of Toronto  
and

L. J. Chapman—Ontario Research Foundation

In 1930, Mr. T. D. Jarvis began a program of work in ecology, that is a study of crop adaptations in Ontario. The environment of plants consists of climate and soil and it is from this viewpoint that the Ontario Research Foundation has looked at the soils of the Province.

In attempting to become familiar with the major soil differences in this area, the want of information about the land forms and glacial or lacustrine deposits that are chiefly responsible for those differences was soon encountered; and since no other agency was tackling this physiographic work, the Ontario Research Foundation took it up and has carried it to a state of near completion for southern Ontario. A series of three articles have been written to appear in "Scientific Agriculture" which summarized the survey work and gave small-scale maps of the surface features. More recently a large map on the scale of four miles to the inch has been prepared as well as a text to go with it. This includes the detail that was omitted from the journal articles. It is mainly an account of the last glaciation, especially the step by step picture of the recession of the Wisconsin ice sheet. Without such an aid to memory it is hardly possible to grasp and retain a mental picture of the soils throughout the province, varied as they are. However, the topographic form of the surface and the kind of rocks making up the deposits are stressed because these are the traits that affect the soil.

When the survey was made in central Ontario none of the counties had been mapped by the regular soil survey from the Ontario Agricultural College. In eastern Ontario only one small county, Grenville, had been mapped, and for these two sections the main soil types were described and mapped on a small, highly generalized map. This information was also presented through the medium of Scientific Agriculture. The section west of the Niagara Escarpment was studied last and by this time fourteen of the local counties had been mapped by the Ontario Agricultural College soil surveyors. In view of this we have not proceeded to a general description of the soils for this third section of southern Ontario, leaving that to the Ontario Agricultural College.

It might be well to include in this memorandum a brief mention of the climatic research done by this department even though it is only complementary to a study of soil. By making an analysis of the records collected by the Dominion Meteorological Service a series of climatic maps and tables were prepared that have filled a gap in the knowledge of the conditions under which farmers work in the province. This was only completed for the part south of North Bay. A similar set of maps is compiled for northern Ontario but owing to a lack of familiarity with that part of the province, the account of its climate has not yet been written.

In view of the steady demand for the foregoing information about climate, it is urged that further work of a more detailed nature on climate for the use of crop ecologists could very profitably be undertaken.

Having made a complete survey of physiography on a certain scale of detail in southern Ontario, it now becomes necessary to make it available to anyone who can use it. The three published articles are bare summaries and the maps contained in them only very small. The publication of a bigger, detailed map with a full text and supplementary maps and illustrations is undoubtedly a primary need. Repeatedly, requests have been made for copies of the four-miles-to-the-inch map. Work towards having it printed has been stalled for over a year due to the wartime dearth of men and materials, but it is hoped that a start can be made on it soon.

The Foundation has always been willing to spend the time necessary to go into the field with members of government departments, who were directly interested in our maps and has received similar aid in turn by the soil surveyors under the Department of Agriculture. This fall a member of the staff spent three weeks with the soil specialists of the Highways Department because they asked for a first-hand interpretation of land forms and materials. The Departments who are most directly concerned are: (a) The Ontario Agricultural College (Department of Agriculture); (b) The County Representatives; (c) Department of Lands and Forests; (d) Department of Planning and Development;

Occasionally there have been inquiries from high school teachers for material on climate or glacial geology or soil. In fact it is expected that one of the widest uses to be made of this work will be made in high schools. Here again this development will wait on the publication of a monograph about it.

## FUTURE PROGRAM OF ONTARIO RESEARCH FOUNDATION

### L. J. Chapman—Ontario Research Foundation

During a recent conference it was agreed that our physiographic survey should cover Manitoulin Island, the main argument being that this would give full coverage of all the farming country south of the Pre-Cambrian rocks. At the same time representatives of the Department of Lands and Forests asked when similar work would be undertaken in northern Ontario.

As it stands at present the published accounts of physiography lack detail as to the composition of the soil-forming materials. They include only an estimate of the proportion of the various limestones, dolomites, shales and sandstones of glacial drift in southern Ontario and rock of Pre-Cambrian age. A mineralogical study of the glacial drift in southern Ontario would give a much clearer understanding of soil development. This would require a man with training in mineralogy and in the use of instruments for physical testing. It is specialized work not now being carried on in the province and would probably take several years to complete the study. A better understanding of the release of minerals from the solid particles to the soil solution would assist us in giving sound advice about soil management.

Our account of climate needs to be supplemented. The increasing demand for dividing the province into zones adapted for certain crops, of for specific varieties, requires the study of climatic phenomena having a special bearing on those crops. So far only average conditions have been defined and if possible the Ontario Research Foundation will proceed soon with a more detailed analysis of existing weather records. It may be that more recording stations similar to the one set up last year at Redickville will be asked of the Dominion Meteorological Service.

Supplementary studies of local variations due to the lay of the land might well be carried out. This is recommended as a good project for students in natural science or agriculture and we should like to secure the co-operation of the Department of Education.

A set of climatic maps has also been made for northern Ontario. However, due to the scarcity of long-time records, and more particularly to our personal unfamiliarity with that region, we have not seen fit to publish an account of climate for that part of the province. The maps are being kept for reference until these limitations can be overcome.

During the past thirteen years preliminary notes have been made of the trees and smaller plants found growing naturally on the various types of soil throughout southern Ontario. With the completion of the physiographic survey the correlation of plants and specific soil types has commanded more attention. Such work furthers that knowledge of the landscape which is needed in making maps of zones for specific crops. Incidentally, this botanical approach may lead to a very practical grouping of our soil types, which will be useful to the crop specialists. There is also the promise of finding some species naturally distributed which will serve to guide the agronomists in giving advice as to where cultivated varieties should or should not be grown,

To summarize, our future work may be listed as follows:—

- (a) Finish physiographic and climatic study of southern Ontario and publish reports and maps,



- (b) Extend the above to Manitoulin Island as soon as possible, and eventually to northern Ontario, particularly those areas in which the Department of Lands and Forests is directly concerned.
- (c) Initiate and maintain an investigation of mineralogical composition of Ontario soil types.
- (d) Continue study of the natural flora in relation to soil type.

With regard to staff: At present this work is carried on at The Foundation by one man assisted in the summer months by Professor Putnam. To make any speed with the above programme at least two additional men must be secured and given permanent employment. The additional cost would be around \$10,000.

# GRADUATE TRAINING AND AIDS, (SOILS)

\*C. A. Rowles Ontario Agricultural College

## I. Problem

In the opinion of the group which met November 2nd, 1945, to discuss soil research in Ontario, one of the most serious factors adversely affecting soil investigations at the present time is lack of adequately trained staff. An important problem to be faced therefore is how best to encourage more students to take specialized training in soils.

## II. What is Involved in Soil Specialization

1. Soil is a colloidal complex consisting of minerals, living and dead organic material, water and air, therefore all students of soil must be thoroughly based in the natural sciences, notably Chemistry, Mathematics and Physics. The mineral fraction of soil is derived from the weathering of geological material, and students must also have some knowledge of Geology. In addition, some of the most fundamental soil reactions are due to micro-organisms and an understanding of Bacteriology is important. If the soil specialist is concerned with the soil as a medium for the growth of higher plants, it is essential that he have a knowledge of Botany, Plant Physiology and Agronomy. Students specializing in other phases of soils, such as Soil Mechanics, will require specialized study in other sciences.

2. Because soil science depends upon so many branches of study, the training of soil specialists presents considerable difficulty. It has been found that the undergraduate timetable is so filled with essential supporting classes that only the general fundamental principles of soil science can be included. Therefore specialization must usually be left for graduate study. This specialization may be in any one of a number of fields, such as soil classification and survey, land use planning, soil chemistry, soil physics, forest soils, etc.

## III. Factors Responsible for the Problem

1. The meeting of November 2nd expressed the opinion that the shortage of soil specialists was primary due to four factors, as follows:—

- (i) The growing demand for soil specialists in industry and various branches of government.
- (ii) The lower salaries offered in soil science as compared to industry and other professions.
- (iii) Lack of facilities for giving basic undergraduate training in soils.
- (iv) Lack of facilities and encouragement for students to take specialized graduate training in soils.

2. The meeting felt that with the growing recognition of the importance of proper soil use, the increasing demand for soil specialists will continue, and it is hoped that this may lead to improved salaries. Therefore, our main concern should be with factors (iii) and (iv), undergraduate and graduate training.

3. The training of soil specialists has recently received special attention at the Ontario Agricultural College with the formation of a Soils Department. Additional laboratory space is under construction and consideration is being given to the introduction of a Soils Option. This should greatly stimulate undergraduate training in soils.

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\*Now with University of British Columbia.

4. It is the opinion of the groups interested in soil research that special attention must also be given to the matter of encouraging students to take specialized graduate training in soils. These groups also believe that the most desirable and effective method of encouraging such specialized study would be to provide graduate fellowships for the use of students specializing in soils. Nothing at present is being done in this regard, and such fellowships would enable students to continue their studies and at the same time undertake research on soil problems important to the Province. There are many such problems to be undertaken, and the following are a few which could usefully be undertaken at the present time. Other important problems are included in the minutes of the November 2nd meeting. It should be noted that most soil problems require a certain amount of field work, which necessitates that allowance be made for travelling expenses.

- (i) Study of soil properties in relation to run-off and soil erosion.
- (ii) Study of the physical and chemical properties of specific soil types.
- (iii) Study of classification, properties and use of organic soils for the improvement of mineral soils.

#### IV. Recommendations

In view of the considerations outlined above, it is recommended that:

1. Funds in the amount of \$15,000 annually be made available for the granting of fellowships for special study and research on soil.

2. A special continuing committee be organized to deal with the selection of candidates, choice of research projects and allocation of funds. This committee should also be responsible for setting down details of the fellowship plan within the following general outline, which includes the three main groups of fellowships considered necessary.

- (i) Five to eight fellowships in the amount of \$500 to \$600 annually, open to university graduates who have shown high academic ability and an aptitude for specialization in soils. The purpose of this group of fellowships would be to encourage the right type of student to compete for the Master's Degree at institutions in the Province. The fellowships should, therefore, be renewable for a second year, providing the student has shown satisfactory progress during the first year.
- (ii) One or perhaps two fellowships in the amount of \$700 to \$1000 annually, open to holders of the Master's Degree in some branch of soil specialization. The purpose of this type of fellowship would be to encourage students of exceptional ability to compete for Doctor's Degrees. The fellowships should be renewable for a second year and the candidate should be allowed to take them up at any institution approved by the committee.
- (iii) One or perhaps two research fellowships available annually to researchers in soils whose research makes it advisable that they go to some other institution for study or make use of special equipment in connection with their problem. This type of fellowship is extremely valuable in soil research and has not received sufficient attention in the past. The extent of the funds and time allotted to such projects should be left to the discretion of the Fellowship Committee.
- (iv) Consideration should be given to special fellowships for veterans.



# EDUCATIONAL MATERIALS IN THE FIELD OF SOIL SCIENCE

**D. F. Putnam, Department of Geography,  
University of Toronto**

Mr. Chairman and Members of the Ontario Research Commission:

You have been presented with many statements concerning the objectives, methods and results of Soil Research in Ontario; may I, at this time, place before you the importance of the educational phases of soil science. All scientific education is, and must be, based upon scientific investigation, hence we, as soil research workers, feel that a direct responsibility rests upon us to ask that proper educational material be provided for the interpretation of our findings to students at all levels. I suspect that it is our fault that such educational aids are lacking in our Province, and indeed in the whole country, but soil science in Canada is fairly young and we have been very busy laying its foundations. Perhaps I may add weight to my argument by pointing out that only this year has the Ontario Agricultural College, our oldest institution for the advanced study of agriculture, established an independent soils department; and only within the past five years at the University of Toronto has a course in Pedology been offered.

The educational point of view, however, embraces a wider vista than just instruction at university levels. The need is urgent also in the secondary schools, collegiates and vocational, in the public or primary schools and in that broad and rather informal field which we may term "adult education." Each of these fields requires special attention, each requires material prepared in accordance with its own educational objectives and couched in language understood by its own pupils. In a few words I propose to outline the situation in each of these cases.

## **I. The University Level**

There is not in existence a Canadian textbook on soil science suitable for use in the classrooms of a university or agriculture college. All available texts have been written and published either in the U.S.A. or in Britain. Soil science may not be, and probably is not, alone in this unenviable position; nor do we ever hope to see the day when we shall, in sheer independence, disregard all texts produced in other lands. But, soil conditions are essentially geographical in their distribution and soil problems are distinctly local.

We, in Canada, are greatly interested in many questions which find no direct analogy in other parts of the world, save perhaps in the U.S.S.R. We need, therefore, Canadian college material for the teaching of soil science. At that, the university level is better served than any of the others, for many of our prominent soil scientists are teachers in our agricultural faculties. In those universities where agricultural faculties do not exist, most students, even in the natural sciences, graduate with very little knowledge of Canadian soil conditions. For biologists, whether their main interest be plants or animals, this is tragedy.

Therefore, apart from the prosecution and publication of all individual soil researches, be it urged that some thought be given to the preparation of a text which will emphasize Canadian problems and Canadian points of view.

## II. The Secondary School Level

The need for instruction in soil science at the secondary school level has received much more recognition in recent years than in the past. There is still room for much improvement, however, for apart from five periods devoted to conservation in Grade IX, students in General Science get little instruction in soils. The sections devoted to soil in the general science textbooks are entirely inadequate and, in the expressed opinion of some members of this group, definitely misleading. Where agricultural science is taught, the situation is much better for, apart from the same five period course in conservation in Grade IX, the courses of study for Grades X, XI and XII prescribe at least fifty periods in which topics related to soils and soil fertility are discussed. In the opinion of some of us, this course rather puts the cart before the horse, since soil conservation can be much better understood after some of the fundamental facts have been mastered.

Wouldn't it surprise you to learn that in the lists of reference books which accompanies these courses of study there is not one relating specifically to soils?

There is, then, a very definite need for educational material at the secondary school level, based on the findings of our own research. That need is all the more compelling from the fact that few high school teachers have had much specialized training in soil science and hardly any at all have ever had research experience.

## III. Public School Level

The further down the ladder of education, of course, the further we are removed from the direct impact of research findings upon educational materials; yet it is in the public schools, and particularly in Grades VII and VIII that many of the basic facts of science are first presented. Here, out of a book list which abounds in titles concerned with History, English, Mathematics, Shop-work, Home Economics, General Science, etc., there is none listed as specifically referring to the soil, which in the last analysis is the basis of our civilization. Hidden away under the title "Basic Science Education Series—several titles," there is one entitled **Soil**, but in order to find that out it is necessary to apply to the publisher! It is an excellent little pamphlet of some thirty-six pages—but its presentation is entirely American, and we need illustrations of Ontario conditions for Ontario pupils. Mention should perhaps be made here of *Conservation Illustrated*, published by the Canadian Nature Magazine, Toronto. It is a 32-page booklet containing ten short articles, one of which is entitled **Soil**. It is also crammed with illustrative drawings and photographs. But, even for public school levels this constitutes very inadequate source material for the teaching of soil knowledge—a knowledge which is a fundamental right of every citizen.

## IV. The Field of Adult Education

This field is extremely broad, and its needs are as yet but vaguely understood. It is therefore somewhat difficult to suggest the form in which the results of soil research should be made available to workers and students in this field. I was much interested in a brief recently presented to the Commission on Education asking for the establishment of a **People's College** in Simcoe County. The objective of this institution was stated to be the teaching of the moral subjects, philosophy, history, etc.—the basis of civilization. Simcoe is also a county

which is much interested in its soils, and, in fact, the conservation of all of its natural resources. There is much that is moral, philosophical and historical in the study of soil resources and their exploitation.

In the field of adult education, then, there is a large and varied audience to which the story of soil science should be told and we feel that as soil research workers we have an interest in it.

In soil science, we are faced with an almost complete lack of teaching material at all educational levels, and it behooves us to enquire what should be done about it. Soil science, of course, has two phases: one, the application of fundamental physical and chemical principles; the other, being descriptive, geographical and illustrative. In elementary education, however, the two must be presented hand in hand. Now, it is popularly supposed to be the Province of the teacher to transmute scientific findings into teaching material; but since we have yet to teach the soils language to the teachers, we are going to have to supply not only the basic information but teaching application as well.

In so far as Ontario is concerned, we need, first and foremost, a general account of the soils of the Province, together with a map (or maps), which will summarize the results of the detailed surveys already made and anticipate the findings of those yet to be carried out. Such an account exists for Saskatchewan, making it comparatively easy to develop an understanding of the soils of that Province—at the University level at least. It is certainly much harder to present a connected picture of the soils of Ontario from a group of county maps and but two published reports. Such a report would fill an immediate need since at college levels technical bulletins are also teaching material.

There is not, I think, room for more than one good Canadian soils text; hence, its preparation should be the concern of all Canadian soils specialists. Regardless of who may write it, it should be edited by a committee of the soils section of the Agricultural Institute of Canada and should carry the approval of that body. The support of such a project by the Province of Ontario, is urged upon the Commission because of the need for such a book in Ontario, as well as in the rest of the country.

At the high school level, there should be at least one slim volume devoted to elementary soil science and its application to Ontario conditions. While the high school teaching profession and the Ontario Department of Education would probably have much to offer in the way of pedagogical suggestion, knowledge of the subject can only come from the soil scientist. We have yet to teach the teachers. One comment often heard at the present time is that the results of research are not being made available to those who need them. The results of soil research are certainly needed, and one of the best ways of ensuring circulation is to provide adequate teaching material.

At the public school level, we would urge that at least a booklet of the "unit reader" type be prepared to acquaint Ontario pupils with soil conditions.

All previous discussions have mentioned matters of time, funds, and personnel. The preparation of educational material is in this respect no different from any other project. Men must be assigned to the task, must become familiar with it and must carry it to a successful conclusion. While they are thus occupied, they will, perforce, not be fully active in the research field and an expansion of personnel will therefore be necessary. There are costs of publication also which must be paid out of public funds. In the case of textbooks, once demand is



established, there will probably be publishing houses willing to accept the responsibility, but the costs of bulletins and like teaching aids will have to come from the public purse.

I realize that I have mentioned many matters before this Commission which might almost equally well have been carried before the inquiry into education. I have tried to point out, however, that under present conditions the matter is almost inseparable from research itself. Moreover, there is no doubt in my mind, or in the minds of my colleagues, concerning the far-reaching importance of the educational phase of soils work. We therefore bring it to your attention and respectfully urge that it be given earnest consideration.

RECOMMENDED PROJECTS—SOILS RESEARCH—1947-48

Title	Agency	Capital	Operating	Total
Physiography	ONTARIO RESEARCH FOUNDATION. . . .	\$2,100.00	\$14,900.00	\$17,000.0

## COMMITTEE ON FISHERIES AND WILDLIFE RESEARCH

### Meetings

Informal—Nov. 10th, 1945.....	Ontario Research Foundation Library
—Dec. 1st, 1945.....	“ “ “ “
Advisory Committee—April 6th, 1946	Committee Room, No. 1, Parliament Buildings
—Aug. 19th, 1946	Queen's Biological Station, Chaffey's Locks, Ont.
—Oct. 5th, 1946	Royal Ontario Museum
—Nov. 9th, 1946	Royal Ontario Museum

### Committee

Dr. W. J. K. Harkness.....	Lands and Forests
Prof. A. E. Coventry.....	University of Toronto, Zoology Dept.
Dr. A. E. Warren.....	McMaster University
Dr. W. H. Johnson.....	University of Western Ontario
Dr. H. W. Curran.....	Queen's University
Dr. J. R. Dymond.....	Royal Ontario Museum of Zoology
Dr. A. M. Fallis.....	Ontario Research Foundation
Mr. H. H. MacKay.....	Lands and Forests
Dr. C. H. D. Clarke.....	Lands and Forests
Mr. K. M. Mayall.....	Planning and Development
Dr. A. O. Blackhurst.....	Federation of Commercial Fishermen
Mr. W. Austin Peters.....	Ontario Federation of Anglers and Hunters
Mr. Len Hughes.....	Ontario Tourist Trade Association
Dr. F. E. J. Fry.....	University of Toronto
Dr. R. R. Langford.....	University of Toronto
Dr. F. P. Ide.....	University of Toronto
Mr. E. C. Cross.....	Royal Ontario Museum
Mr. Lester Snyder.....	Royal Ontario Museum
Mr. T. C. McCall.....	Department of Travel and Publicity
Prof. C. E. Atwood.....	University of Toronto

## FISHERIES AND WILDLIFE RESEARCH IN ONTARIO

### General Position in the Economy of Ontario

Ontario's fisheries and wildlife are two resources which, while at present in the category of "wasting" resources, could be maintained at a reasonably permanent level. That they are important resources is generally accepted. It could not be otherwise, since ninety per cent of the Province is blessed with one or both of them, and fifty per cent of the Province will produce no other crop. They provide a direct annual income of some five million dollars a year to commercial fishermen and trappers, who are the primary producers for a number of secondary industries. They provide the chief attractions for the host of tourists who spend in the Province an estimated hundred million dollars a year, an expenditure which makes possible the employment of a number of people in direct catering, and which is the main support for the industries engaged in the manufacture of sporting equipment. Thus they represent an inexhaustible source of exports, provided we realize that Nature's beneficence is not unlimited, and that our privilege of exploiting these tremendous gifts involves the duty

of conserving them. Aside, too, from purely monetary considerations is the fact that they afford to many of our own citizens excellent facilities for recreation, a matter of considerable importance to general welfare.

## **Government Responsibility**

The maintenance of these resources is, of course, left almost entirely to the Government. Since their nature is such that they are exploited for pleasure or for profit by thousands of individuals, no private groups or corporations are in a position to assume as much responsibility as they would where exploitation by a few might be directed by commercial common sense, with a view to permanence. Then, too, the Government derives from these resources revenues to the extent of approximately a million dollars a year, and, as the institution which enjoys the largest direct revenue, it is expected to be responsible for the proper husbanding of them.

## **Present Methods of Conservation**

That that responsibility has been accepted is evidenced by the efforts of the Government to protect both fisheries and wildlife. There have been legal restrictions on the lengths of the hunting and fishing seasons, on the size and the number of the fish taken, and on the number of birds or animals shot. There has been complete protection for some species and there has been considerable re-stocking of game fish and birds. These efforts have modified the effects of too rapid "mining" of these two great resources, but are quite inadequate to provide a complete solution to the problem of constant depletion. They are inadequate, not because they are in themselves useless, but because other factors in the ecology of fish and wildlife—settlement, cultivation of the soil, deforestation, construction and destruction of dams, and the pollution of water with sewage and industrial wastes—may be detrimental to the purpose behind our present efforts. These other factors cannot be ignored and any comprehensive long-term programme aimed at correcting the basic causes of depletion must be based on adequate knowledge of all the favourable and unfavourable factors.

## **Present Situation**

To date biological research is wholly inadequate to provide the information necessary for the proper administration of Ontario's fisheries and wildlife resources. As a matter of fact, aside from the collection of valuable data by the Royal Ontario Museum of Zoology over a period of years, there has been no systematic investigation of terrestrial wildlife in the Province. As a result our legislation and our practices have been based more on opinion than on scientific knowledge. The present bounty on "wolves" may be defeating its real purpose—that of deer protection—and it is not unlikely that agriculture may be paying a considerable penalty for our constant warfare against hawks, owls, skunks, weasels and foxes. Even the lowly forest mouse may provide an administrative riddle, for, while it is known to occupy a prominent place in the diet of our fur bearing animals, its depredations may be deterring forest regeneration or it may equally well be controlling some insect pests by eating their larvae.

While fisheries research is in a much happier position, historically, it is still too woefully inadequate to justify much confidence. We are still without reliable data concerning the capacity of waters to maintain a stock of fish, either as regards population or species, and we are without complete information regarding



the temperature and depth limits for all the various species. Moreover, there are tremendous gaps in our knowledge regarding the part soil fertility, deforestation, water pollution, etc., play in the ecology of the fish.

### Existing Machinery for Research

There are in the Province sufficient institutions for the development of the comprehensive investigations essential to any successful approach to a programme of restoration and conservation. Each of the four universities offer much in the way of skilled help to direct research programmes and to assess the results. The Ontario Research Foundation and the Royal Ontario Museum of Zoology are in a position to make significant contributions, while the various Government Departments—Lands and Forests, Travel and Publicity, Health, Planning and Development, Tourists and Publicity—together with the Ontario Federation of Commercial Fishermen, the Ontario Federation of Anglers and Hunters, and the Ontario Tourist Trade Association, may all play a major part. In addition, the Great Lakes Fisheries Board, while outside the orbit of Provincial control will, no doubt, render invaluable assistance in its own field.

There is, then, no need for additional organizations to undertake a complete programme of research. What is required is that the efforts of existing institutions be co-ordinated and extended, so that the peculiar talents of each may be fitted most efficiently into an integrated Provincial programme. The universities, for instance, given the financial help required for extension of their facilities, are best suited to undertake projects of fundamental research, while the various Government Departments concerned, either in themselves or through increased facilities at the Ontario Research Foundation or the Royal Ontario Museum of Zoology, might concern themselves with investigations which have to do with problems of administration. Both the Foundation and the Museum could, of course, undertake pure as well as ad hoc research, while the Ontario Federation of Commercial Fishermen and the Ontario Federation of Anglers and Hunters and the Ontario Tourist Trade Association could materially assist in the collection of data and in extension work at the "consumer" level. The allocation of responsibility is, however, of minor importance here. The main consideration is that the required machinery exists at every level.

### The Requirements

While there are sufficient organizations to undertake an adequate programme of research, they are, in the cases of the universities and the Foundation at least, badly handicapped by limited and obsolete facilities, and by a shortage of personnel. To a large extent research on fisheries and wildlife has had to be relegated to a position of minor importance, to an uncertain and disjointed existence, with recurrent revivals when space, time, and money permitted. In such circumstances there can be little doubt that much of the value of the work accomplished was lost.

The immediate needs may be summarized as follows:—

#### (1) Provision of Personnel:

- (a) The establishment of scholarships with a view to encouraging post-graduate work in the field of fisheries and wildlife.
- (b) The institution of a policy of employment preference for scientifically trained personnel in the administration of these resources to offer further encouragement to students in these fields.

- (c) The institution of a policy of employment preference for undergraduates in these fields in temporary summer appointments for purposes of administration.
- (2) Extension of Facilities and Staff
  - (i) Queen's University—Further extension of the laboratory at Lake Opinicon.  
Research personnel.
  - (ii) University of Western Ontario—Provision of a barge which may be used anywhere on Lake Erie.  
Research personnel.
  - (iii) McMaster University—Additional facilities for investigations re Dundas Marshes and Lake Ontario.  
Research personnel.
  - (iv) University of Toronto—Temporary or permanent laboratory with space far beyond what exists at present.  
Research personnel.
  - (v) Departments—Additional facilities and personnel in the Provincial Parks and River Development Areas and extension of projects contemplated.
  - (vi) Ontario Fisheries Research Laboratory.  
Research personnel.
  - (vii) Ontario Research Foundation—Addition in the field of Parasitology.
  - (viii) Royal Ontario Museum of Zoology.  
Additional staff.
  - (ix) Ecological Centre.

## ROYAL ONTARIO MUSEUM OF ZOOLOGY

At its meeting in Toronto on November 9th, 1946, the Advisory Committee on Fisheries and Wildlife gave consideration to the place of the Royal Ontario Museum of Zoology in an integrated programme of fisheries and wildlife research in Ontario.

The Committee wish to emphasize that the Museum has an essential place in fisheries and wildlife research and that if it is not enabled to fulfil its function adequately, the whole programme will be weakened.

### **The Research Fields of Zoology Belonging to Museums**

TAXONOMY or classification including identification, which is basic to every other branch of Zoology, is the special responsibility of museums. Unless the investigator has his animals properly identified, he may be led astray in his conclusions and lead others astray so that confusion rather than enlightenment is the result of his work.

Every properly organized museum has specialists in the identification and classification of mammals, birds, reptiles, amphibians, fishes, insects, and every other animal group, including parasites which belong to several groups.

Museum house collections of such animals which are as necessary for reference in identification and in taxonomic research as books are to a library.

For the identification of bones and other parts of animals found in the stomachs or droppings of animals whose food habits need identification, museums prepare and preserve collections of the skeletal and other parts of animals.

The care of its scientific collections is a permanent responsibility of museums.

DISTRIBUTION studies are of economic as well as of theoretical importance. Knowledge of the geographical and ecological distribution of an animal is valuable in indicating the conditions (a) necessary to be maintained for its success in its original habitat (b) responsible for its disappearance from situations in which it originally thrived and (c) under which it might succeed if transplanted.

**The Museum's Educational Responsibilities** in fisheries and wildlife are to the University, the schools, and the general public.

Students in training for positions in fisheries and wildlife need to know the mammals, birds, reptiles, amphibians, fishes, insects, molluscs, parasites, etc.

A constant flood of inquiries about animals comes to the Museum by letter, telephone and personal call from teachers, sportsmen, naturalists, authors, newspaper writers, authors, radio broadcasters and ordinary citizens.

### **The Museum's Service to the Department of Lands and Forests**

The Department of Lands and Forests depends on the Museum for service for which it would have to provide staff and collections of its own if the Museum were not available.

### **The Needs of the Museum of Zoology**

The Royal Ontario Museum of Zoology is not adequately staffed to meet its obligations as a Provincial Museum. It has curators in only two divisions,



namely birds and insects. It has no one in charge of such important divisions as mammals and fishes. It has recently lost its taxidermist and two other members of its staff because of inadequate salaries, which are in some cases from \$500 to \$1200 too low. It has very meagre funds for field work, purchase of specimens, publication, etc. Funds for all non-salary purposes are less than half what they were before the war and even then they were inadequate.

If the Royal Ontario Museum of Zoology is to provide the service in connection with research, administration and education in fisheries and wildlife, it must be given much more adequate support than now seems likely through ordinary channels. Even if funds were available it would be impossible to staff the Museum adequately at once. Personnel for the work to be done in a museum must be specially trained. Without reasonable prospects of a position being available, students will not undertake the necessary training. To serve the University, the Department of lands and Forests and the public in the matter of fisheries and wildlife research and education, the Museum of Zoology needs:—

- Curator of Mammals.
- Curator of Fishes.
- Curator of Parasites.
- Curator of Invertebrates other than insects (resigned and cannot be replaced on former salary).
- Additional Entomologist (for forest insects among others).
- Taxidermist (resigned and cannot be replaced on former salary).
- Artist Assistant to assist in preparation of illustrations for fisheries and wildlife publications.
- Wildlife Food Habits Research personnel.
- General Attendant for cleaning inside gallery cases, cleaning laboratories, packing and unpacking, acting as supply clerk and messenger. All these must now be done by higher paid personnel.
- Additional clerical and cataloguing assistance for above.
- Publication Fund for popular and scientific publications.
- Increased Appropriation for storage and gallery cases (\$650.00 at present), specimens and collecting (\$200.00 at present), library (\$100.00 at present), field work (\$500.00 at present).

It is suggested that a five-year programme of gradual expansion of the Museum of Zoology staff and work be undertaken looking to the realization of the expansion outlined above. To accomplish this, it is estimated that the following increases in appropriations would be necessary.

1947-48.....	\$17,850 over 1946-47
1948-49.....	13,000 over 1947-48
1949-50.....	10,000 over 1948-49
1950-51.....	10,000 over 1949-50
1951-52.....	8,000 over 1950-51

Details of the increased appropriations suggested for 1947-1948 are as follows:—

<b>Personnel:</b>	
Salary Increases of Present Staff.....	\$2,200.00
Curator of Fishes (graduate student in training)....	1,500.00
Curator of Parasites (student in training).....	1,200.00
Artist Assistant (part time).....	750.00
Wildlife Food Habits Research Personnel.....	2,500.00
General Attendant.....	1,200.00
Additional Clerical Assistance.....	2,500.00
	<hr/> \$11,850.00
Less Salaries of Taxidermist and Malacologist Resigned, not to be replaced at once.....	4,200.00
<b>Total.....</b>	<b>\$ 7,650.00</b>
<b>Field Work, Maintenance, etc.:</b>	
Field Work Fund Increase.....	\$ 2,000.00
Publication Fund.....	1,000.00
Cases, Specimens, Library and Miscellaneous Operating Increase.....	7,200.00
<b>Total.....</b>	<b>\$10,200.00</b>

It is suggested that the Ontario Research Commission consider financing the following projects which are included under various items above, such as curator of parasites, wildlife food habits research, additional clerical assistance (part), field work, cases (part):—

Natural History Survey of Cape Henrietta Maria, Hudson Bay ..	\$1,500.00
Wildlife Food Habits Research.....	3,500.00
Reference Collection of Animal Parasites.....	2,000.00
Compiling Records of Populations of Ontario Animals.....	500.00
	<hr/>
	\$7,500.00

This would leave \$10,350.00 additional to the present Museum of Zoology appropriation to be financed through regular Museum appropriations (Department of Education).

Details of each of the above four projects suggested for financing through the Ontario Research Commission are attached.

**Natural History of Cape Henrietta Maria**

Previous to 1938, very little had been added to our knowledge of the natural history of the northern half of Ontario, beyond what we owed to Graham, Martin and Hutchins, Governors of Hudson's Bay Company posts on Hudson's Bay, who between 1768 and 1782 sent specimens and records from that area to England.

Beginning in 1907, the Carnegie Museum of Pittsburgh has sent 21 expeditions to the area east of Hudson's Bay.

In 1938 the Royal Ontario Museum of Zoology was given a grant of \$5,000 from the Reuben Wells Leonard Fund to enable it to carry out natural history surveys in the District of Patricia. Under this grant the following surveys were carried out:

- 1938 Favourable Lake area near the Manitoba boundary.
- 1939 Lake Attawapiskat.
- 1940 Fort Severn on Hudson Bay.
- 1942 Fort Albany on James Bay.

In 1942 an attempt was made to visit the Cape Henrietta Maria area but owing to an accident to the Hudson's Bay Company boat, which was to have taken our party there, it was not possible to reach it

An indication that this area has interesting and important wildlife problems is afforded by the fact that the Arctic Institute of North America has awarded a fellowship to Harold C. Hanson of the Illinois State Natural History Survey for wildlife research on the west coast of James Bay.

Surely Ontario can afford to enable its Provincial Museum to investigate the fauna of our own areas.

Estimated Cost of this Survey.....	\$1,500.00
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**Wildlife Food Habits Research**

Knowledge of the food habits of fish and wildlife is basic to any programme of management.

There is immediate need of means for determining the food of moose as part of the Museum's moose research being financed by the Carling Conservation Club.

The Museum has a large collection of stomachs, scats and pellets whose examination would throw light on the relation of birds to forest insects and on the interfood relationships of mammals.

Need for the services of a wildlife food habits research laboratory will increase as studies on the life history and ecology of animals increase.

The Museum is the natural home of such a laboratory since it has collections of the mammals, birds, reptiles, amphibians, fish, insects, etc., of the Province.

Such a laboratory would need a microscopist, skilled in the identification of finely ground plant and animal material.

<b>Estimated Cost:</b>	
Microscopist.....	\$2,500.00
Equipment and Storage Cases.....	1,000.00
	<hr/>
	\$3,500.0

**Reference Collection of Animal Parasites**

Study of the parasites of wild and domestic animals has heretofore been very inadequate in Ontario.

In connection with various fish and wildlife studies (ciscoes, burbot, lake trout, maskinonge, ruffed grouse, pheasant, mice, deer, moose, etc., etc.), parasites belonging to many groups are found. At present there is no organized means of preserving specimens of these parasites except in the case of the few kinds receiving special study. In the future as arrangements are made for the study of more and more of these parasites a collection, not only of named specimens but of material that has not yet been studied, will be of very considerable value.

As the preservation of material of this kind is a recognized museum function, it is suggested that the collection of animal parasites be initiated by granting a research scholarship to a student to begin a taxonomic study of some group of parasites and to build up and care for a general collection.

<b>Estimated Cost:</b>	
Graduate Student.....	\$1,200.00
Field Expenses.....	300.00
Equipment.....	500.00
	<hr/>
	\$2,000.00

**Compiling Record of Populations  
of Ontario Animals**

The need for this item was outlined in the first list of projects presented to the Commission.

If the proposed Ecological Centre will take over this work, the Museum will drop this request.

Previous to the present development of interest in wildlife research, when practically nothing was being done in this field in Ontario, the Museum initiated and carried through this project for ten years. This continuous record will be of value in future studies of animal populations and should be continued by the Museum until some other organization will take it over. It has interfered



Title	Contributing Agencies	Capital	Operating	Total
UNIVERSITY OF TORONTO Penetration of Light into Water	Ont. Fisheries Research Lab., Dept. of Lands and Forests (Professor R. R. Langford)		650.00	650.00
Movement of Lake Trout in Relation to Temperature	University of Toronto, Dept. of Lands and Forests (Prof. F. E. J. Fry)		1,000.00	1,000.00
Bibliographic Research	Professor's Fry, Langford and Ide		2,500.00	2,500.00
Organization of Ontario Fisheries Research Laboratory Library			1,200.00	1,200.00
Supply and Fate of Chemical Nutrients in Lakes and the Chemical Analyses of Organisms	Ont. Fisheries Research Lab., Dept. of Lands and Forests (Fry and Langford)		1,175.00	1,175.00
Caloric Requirements of Lake Trout	University of Toronto and Dept. of Lands and Forests		1,000.00	1,000.00
Relation of Dissolved Minerals to the rate of Growth and Reproduction of Algae	Ontario Fisheries Research Lab., Dept. of Lands and Forests	1,000.00	1,050.00	2,050.00
Lethal Limits of Temperature in Stream Insects with Special Reference to their Thermal History	Ontario Fisheries Research Lab., (Ide and Fry)		1,100.00	1,100.00
Bionomics of the Lake Trout Population of Lake Louise, Algonquin Park	Ont. Fisheries Research Lab., Dept. of Lands and Forests		1,400.00	1,400.00
ROYAL ONTARIO MUSEUM Natural History Survey of Cape Henrietta Maria, Hudson Bay		\$1,000.00	\$12,575.00	\$13,575.00
Wildlife Food Habits Research Reference collection of animal parasites		1,000.00		1,500.00
Compiling Records of Populations of Ontario Animals			2,500.00 2,000.00	3,500.00 2,000.00
McMASTER UNIVERSITY Ecology of the Muskrat	(In addition the Royal Ontario Museum are requesting \$10,350 additional appropriation from regular sources)	\$1,000.00	\$6,500.00	\$7,500.00
Study of Physico-Chemical Conditions in the Bay and Marsh Waters	McMaster, Dept. of Lands and Forests, Hamilton Harbour Commission, Royal Botanical Gardens (Mr. L. Wragg)	500.00	2,630.00	3,130.00
Collection and Identification of the Flora of the Dundas Marsh Region	McMaster, Lands and Forests, Hamilton Harbour Commission, Hamilton Dept. of Health, Royal Botanical Gardens (R. E. M. Kay and E. Turner)	500.00	1,675.00	2,175.00
The Collection and Identification of Fish Species Indigenous to the Marsh Area	McMaster, Lands and Forests, Hamilton Harbour Commission, Royal Botanical Gardens (W. W. Judd)	300.00	375.00	675.00
A Study of the Capacity for Survival in Local Waters of an Introduced Variety of the Minnow Gambusia	McMaster, Hamilton Dept. of Health, Royal Botanical Gardens (A. E. Warren)	50.00	650.00	700.00
Life History of the Carp	McMaster (A. E. Warren)		735.00	735.00
Study of Aquatic Insects	McMaster, Royal Botanical Gardens, Hamilton Dept. of Health (W. W. Judd)	350.00	825.00	1,175.00
Mammalian Fauna of the Royal Botanical Gardens and Surrounding Areas	McMaster, Royal Botanical Gardens (A. E. Warren)	300.00	850.00	1,150.00
Station Wagon		1,600.00		1,600.00
Boathouse		2,500.00		2,500.00
Office, Secretarial, etc.			1,940.00	1,940.00
QUEEN'S UNIVERSITY Services of full time limnologist		\$4,100.00	\$10,480.00	\$16,580.00
Construction of Research Laboratory for investigations in fisheries, entomology and bacteriology		3,800.00	2,000.00	2,000.00
Equipment for fisheries work, seines, nets, ekman dredge		400.00		400.00
One 15' ship Salaries for 2 undergraduate men (3yr.) as research assistants at \$100 per mth. for 4 mths.		160.00	800.00	160.00 800.00
Publication of reports and scientific articles			200.00	200.00
Board for 2 research assistants—4 mths. at \$30 per mth.			240.00	240.00
UNIVERSITY OF WESTERN ONTARIO Study of Ecological Factors of Lake Erie most likely to have influence on fish population Entomology Maintenance Salaries Living Expenses Salary for General Utility Man (to run boat 6 mths. at \$175)		9,273.00	1,400.00 1,400.00 8,320.00 2,184.00 1,400.00	9,273.00 1,400.00 8,320.00
		\$9,273.00	\$13,304.00	\$22,577.00
ONTARIO RESEARCH FOUNDATION Parasitology		\$2,000.00	\$20,000.00	\$22,000.00
TOTAL FOR FISHERIES AND WILDLIFE RESEARCH		\$23,733.00	\$66,099.00	\$89,832.00



with other work which more properly belongs to the Museum. The carrying on of such projects, rather than its more legitimate work, may be the reason the Museum has not been supported more adequately.

Estimated Cost . . . . . \$500.00

ECOLOGICAL CENTRE

The Fisheries and Wildlife Advisory Committee has recommended the development of a fully equipped and fully staffed Ecological Centre to form an integrated part of the whole Fisheries and Wildlife Research Programme within the Province. Since such a centre cannot rise fully developed from thin air, it is recommended that as a beginning an attempt be made to obtain about 4,000 square feet of space in reasonably close proximity to Queen's Park. (10 minutes walk.) The space should have ordinary heating, lighting and plumbing services. If such space could be made available the following groups of workers could be housed immediately.

- A. **Six** graduate students in Zoology (working under the direction of the Department of Zoology).
- B. **Ten** graduate students in Forest Entomology (working under the direction of the Department of Forest Entomology).
- C. **One** librarian with assistant working on animal population data under the direction of the Royal Ontario Museum of Zoology and the Fisheries and Wildlife Division of the Department of Lands and For sts.
- D. **One or two** graduate students working on Wildlife problems under the direction of the Department of Zoology and the Fisheries and Wildlife Division of the Department of Lands and Forests.
- E. **Visitors**—Space for the accommodation of two graduate students working in the Province who may wish for a period to bring their problem to the centre for study.



# COMMITTEE ON FORESTRY RESEARCH

## Meetings—

Informal.....Feb. 20th, 1946—Library, Ontario Research Foundation

## Advisory

Committee.....Sept. 25th, 1946—Committee Room No. 2, Parliament

“ .....Nov. 25th, 1946— Bldgs.

## Committee—

Professor. C. E. Atwood.....	University of Toronto
Mr. A. B. Baird.....	Dominion Parasite Laboratory, Belleville
Dr. W. Boyd Campbell.....	Pulp and Paper Industries Association
Dean G. G. Cosens.....	University of Toronto
Mr. C. B. Davis.....	Abitibi Pulp & Paper Company
Mr. W. A. Delahay.....	Ontario Forest Industries Association
Dr. G. H. Duff.....	University of Toronto
Professor R. O. Earl.....	Queen's University
Mr. D. A. Gillies.....	Gillies Bros. & Co. Ltd.
Mr. O. Holden.....	Ontario Hydro-Electric
Mr. R. Johnston.....	Lands and Forests
Major-General H. Kennedy.....	Ontario Commission on Forestry
Mr. W. LeClair.....	Canadian Lumbermen's Association
Dr. A. Ledingham.....	National Research Council
Mr. D. A. Macdonald.....	Assistant Dominion Forester
Mr. F. MacDougall.....	Lands and Forests
Dr. H. B. Marshall.....	Ontario Research Foundation
Mr. T. A. McElhanney.....	Forest Products Laboratory
Professor R. McLaughlin.....	University of Toronto
Mr. K. O. Roos.....	J. R. Booth Lumber Limited
Professor J. W. B. Sisam.....	University of Toronto
Mr. S. J. Staniforth.....	Staniforth Lumber Co.
Mr. G. H. Tomlinson II.....	Howard Smith Paper Company
Mr. A. H. Richardson.....	Planning and Development

# THE PRODUCTION OF WOOD IN ONTARIO

Prepared by a Sub-Committee of the Major Groups  
in the Province of Ontario Interested in Forestry

## INTRODUCTION

In assessing the importance of any problem, it is helpful to appreciate its size, and its significance to those affected by its solution. On this basis, there should be no question of the size and importance of the forest problem to the Ontario community.

Excluding old Ontario, something on the order of 95% of the Province's land area—about 175 million acres—is occupied by forest stands of some type or condition; it is doubtful if present economic conditions or any economic condition that can be foreseen in the immediate future will materially alter this situation.

As to the importance of the Forest to the Ontario community it is probable that no single individual in the Province does not depend to some extent, or in some form, upon the wood produced from Ontario's forests.

Anyone who has given the matter thought must also realize that in addition to its direct contributions in the form of diversified wood products, the indirect effects of the forest as a source of water for power and fisheries, a shelter for game, an attraction for tourists and a general protection against the drying and erosion of agricultural soils, play a very great and beneficial part in the Provincial economy.

A brief statement here as to the value of the forest to Ontario, and its relation to other natural resources should give point to what has been stated above:

1934

	Agriculture	Forest Industries	Mining Industries
Gross Value of Products . . . . .	\$586,467,000	\$372,000,000	\$232,848,959
Employees . . . . .	317,416 <sup>2</sup>	69,000	33,516
Wages . . . . .	\$383,711,000 <sup>3</sup>	\$104,000,000	\$67,732,244
Area Occupied(sq. miles) . . . . .	7,958,100	118,000,000*	

1—Area south of the Albany-English River line.

2—Hired farm workers only.

3—Cash income from farm products.

Remarks—Value of Tourist Traffic estimated at \$89,000,000.

Unfortunately, many people, and particularly those living in old or Southern Ontario—which differs greatly from the remaining 95% of the Province in climate, soil and topography—do not realize these conditions and problems. Until this large group is aware of this situation, the diversion of adequate funds for forest research will be uncertain and liable to serious interruptions.

## GENERAL RECOMMENDATIONS

### 1. Educational Requirements

At the present time there are few engaged in forest research who have post-graduate degrees in forestry or allied subjects. There has been little encourage-

ment for promising students to do postgraduate work in forestry and there are few facilities for such work in Canada. There are apparently two crying needs at present:

1. Encouragement of promising students to do postgraduate work in forestry and allied subjects in Canada by fellowships by employment during holidays and by prospects of remunerative employment after their university work is completed.
2. Comparative standing for those in research who have no postgraduate degrees with those who have. Some have advanced the rule of thumb that ten years of research experience should equal a doctor's degree.

It will be some time before the field is crowded with postgraduate students and some system of classing the workers is essential.

## **2. Co-operative Groups and Institutions**

### **(1) Universities**

The Universities can aid in this programme by increasing facilities for postgraduate studies and by facilitating research by their staff. The staff should be encouraged to seek outside employment on investigative programmes during the summer holidays.

### **(2) Ontario Research Foundation**

The Ontario Research Foundation is in a good position to carry on a programme of research into fundamental problems of chemistry and biology and to render competent aid when necessary to organizations unable to build up a staff to handle all problems. The National Research Council is also in a position to render such assistance.

### **(3) The Dominion Forest Service**

This organization by history, location and experience is ideally placed to render a valuable service in research, both fundamental and applied. There should be no difficulty about so-called overlapping with other organizations because the field is so large and untouched, that even if all the research workers now available were concentrated on one phase of forestry work, there would be no duplication of work or waste effort. The field of the Dominion should probably be predominantly fundamental research and that of the Province mainly applied research.

## **3. Co-ordinating Group**

It is recommended that a group made up of representatives from (a) Universities, (b) Dominion Government, (c) Industry, and (d) the Province, should be set up to:

- (i) formulate a completely integrated programme of forest research;
- (ii) provide a common meeting ground for the discussion of forest research problems;
- (iii) act as a clearing house for all research information published and unpublished, relative to any part of Ontario's forest research problem;
- (iv) suggest general lines of research to its member organizations.



## SPECIFIC RECOMMENDATIONS

1. Expansion of present research programme of the Department of Lands and Forests, which includes the following major sub-divisions:
  - (a) Surveys—Forest and Soil Inventories (see Appendix A).
  - (b) Biological Investigations (see Appendix B).
  - (c) Forest Economic Investigations (see Appendix C).
  - (d) Protection and Mechanical-Electrical Investigations (see Appendix D).

Appropriations for the above programme for 1946 provided funds to utilize nearly all of the competent technical staff available. This amount should, however, be increased as technicians now in training become available.
2. Additional forest research stations and demonstration forests should be established to study local forest problems. At least one station should be allotted to each general forest region. These are:
  - (a) The Western jack pine—spruce-poplar forest.
  - (b) The Clay Belt black spruce-poplar forest.
  - (c) The white pine-red pine-tolerant hardwood—Huron-Ottawa Forest.
3. Forest Research is of little value unless its findings can be applied through Forest Management. Neither management nor research can function properly in Ontario's forest area until an adequate transportation system has been developed.
4. An inventory of forest resources is as necessary for Forest Management as it is to any other business. Such an inventory must be obtained and, once secured, should be periodically revised to maintain necessary accuracy.

## CONCLUSIONS

1. A developing forest research programme will require some general organizing agency which will represent:
  - (a) The wood production organizations (governments).
  - (b) The wood harvesting and fabricating organizations (industry).
2. Educational services are urgently required to:
  - (a) Provide research technicians.
  - (b) Provide a body of informed public opinion which will guarantee a continuation of adequate support for forest research under a democratic form of government.
3. The whole problem of forest research has been inadequately financed due to a lack of appreciation of the importance of the general forest problem; forest research cannot now be efficiently expanded as rapidly as is desirable because of lack of trained and competent workers.

As indicated by Appendix "E" which summarizes replies from twelve representative foresters throughout the Province, very little research is at present underway. Recommendations for financial support to cover specific programmes or problems is, therefore, difficult.

In general, however, it is recommended that the Research Advisory Committee (a) secure funds to inaugurate and support fundamental forest research to cover both wood production and utilization in existing research organizations and universities; specific projects to be designated by the co-ordinating group previously recommended: and (b) that, the Commission support the Department of Lands and Forests in its research programme so that applied research projects already undertaken by the Department may be enlarged and in addition co-operative applied research may be undertaken with industry on a larger scale.

Departmental appropriations for this work in 1946 approximate \$400,000.00. An additional \$150,000.00—\$75,000.00 ordinary and \$75,000.00 capital—could be usefully invested in 1947. It is considered that in the present state of our forest problem expenditures for fundamental research and for applied research should be approximately equal.

## APPENDICES

### Appendix A

Soil survey Cochrane and Parry Sound districts. This is a continuation of the programme of 1944 which started in the Port Arthur region to separate forest and agricultural soils. The work was carried to the Cochrane district in 1945 and is to be continued there in 1946, with an extension to the Parry Sound region. A soil laboratory for chemical and physical analysis has been set up near Maple, Ontario.

Forest Inventory Survey: This survey will provide the Department with (a) a complete photographic base survey of Ontario, (b) a forest inventory survey giving quantities of wood and forest conditions.

### Appendix B

Natural regeneration surveys in Port Arthur, Kapuskasing and North Bay districts. To be continued and extended to Kenora district. Covered to the present time about 230,000 acres—13 students employed on this work in 1946.

Experimental slash disposal by chemical means (Pyrogel). This may enable the burning of damp slash in relatively safe weather and simplify the problem of live burning of slash.

Slash disposal by lopping or burning with or without brush destruction by chemical means, 2-4-D, and followed by artificial or natural seeding, also planting. Port Arthur and Kenora districts 300 acres done in 1945 and continued in 1946 on a smaller scale.

Large scale low cost collection of spruce and jack pine seeds without cone picking, seed to be used in experimental restocking of areas now accessible but without conifer. Some of seed to be pelleted and results compared with use of uncoated material, 1946 project.

Biological survey of fish and game resources, Algonquin and Quetico Parks. This is conducted in co-operation with the University and the Museum and is part of a long term project. A fish study laboratory is to be added to the Experimental Station at Maple, Ontario. ¶¶

## Appendix C

Study of stumpage prices or bids for the right to cut on Crown lands. Local variations appear excessive and are to be investigated with the object of protecting the bidder and the Crown.

## Appendix D

DDT spraying for control of spruce budworm in the Port Arthur region with biological check on results. This is a continuation of the programme in 1945 when 100 square miles were sprayed.

Sulphur fume survey in the Sudbury district now in its third year is being continued to determine the existence and the amount of smelter fume damage to Crown forest property.

Mechanical equipment, pump and hose and communication equipment are being tested in the newly completed mechanical building at the Maple Station.

In addition to the above it is proposed to set up a forest research station in the Clay Belt and in the Port Arthur region where all forest problems of these areas can be studied theoretically and by actual practice in the field.

### Appendix D-1

Extract from Article on Spruce Budworm by Dr. Carl Atwood  
Basic Information Required in Connection with the Spruce  
Budworm Problem

(In the following list some of the more obvious gaps in the fundamental knowledge necessary for solution of the spruce budworm problem are indicated together with the organizations which might logically be expected to help fill these gaps.)

1. Forest inventory, including young growth, advance reproduction, etc. Kept up to date by frequent surveys.
2. Study of factors governing regeneration of balsam and spruce on various sites and soil types.
3. Study of physiology of balsam in various forest types, especially in two contrasting areas which produce "good" and "poor" balsam.
4. Studies on flotation of balsam in comparison with that of spruce; comparison of "eastern" and "western" forms.
5. Genetic study of balsam with special reference to the presence of budworm-resistant races.
6. Study factors which influence production of staminate flowers and also seed in balsam.
7. Studies on forest succession in outbreak and non-outbreak areas. (Studies of this type appear to belong logically to the field of activity of either the Dominion or Provincial Forest Services or to botanical departments of Universities.)
8. Studies on composition of forests in relation to budworm outbreaks.
9. Studies on methods of dispersal of the various stages of the budworm including influence of weather.



10. Studies on fertility and fecundity of budworm with special reference to type of food which larvae eat.
11. Studies on sampling methods for budworm populations and also for foliage of infested trees.
12. Determination of upper and lower lethal, preferred and optimum temperature for all stages of budworm.
13. Investigation of life histories and relation to host of all budworm parasites. Also temperature relations of chief parasites as in 12.
14. Detection, classification and study of any existing budworm diseases. (These and similar projects would logically be carried out by the Division of Entomology and the Forest Entomology section of the Department of Zoology at the University.)
15. Methods of distribution and effectiveness of poisons against spruce budworm. (This is now set up as a joint project of the Department of Lands and Forests, Toronto, and the Division of Entomology, Department of Agriculture, Ottawa.)
16. Effect on game and fish of changes produced in the forest as a result of budworm attack.
17. Influence of birds and small mammals on budworm populations at various stages of their life cycle. (Could be handled by Department of Zoology in co-operation with Departments of Game and Fisheries and of Lands and Forests (Toronto) and Department of Agriculture (Ottawa).)

## Appendix E

The questionnaire used to obtain the opinion of professional foresters in both industry and Government service was placed before twelve selected individuals, six in Government service and six in industry. Ten replies were received, five from each group,

In general, the questionnaire asked for information on two points (1) a record of research to provide a statement of work completed and under way, planned and desired and (2) a statement of the general class of problems considered most urgent.

### SUMMARY OF STATUS OF RESEARCH

	Agencies Polled	Replied	Research Completed	Research in Hand	Research Desired
Industry.....	6	5	1	1	5
Government...	6	5	2	1	5

### PRIORITY OF RESEARCH PROJECTS

	Regeneration		Survey		Protection	Silviculture	Mechanical Equipment
Industry.....	First	3	First	1	First	2	..
	Second	1	Second	1	..	..	..
Government...	First	2	..	..	First	1	..
	Second	2	..	..	Second	2	..

# RESEARCH ON THE UTILIZATION OF WOOD IN ONTARIO

Prepared by a Sub-committee of the Major Groups in the Province  
of Ontario Interested in the Forest Industries

## A. The Forest Industries and Research

The importance and value of expenditures on research in any industry might be said to be in direct proportion to the value, both actual and potential, of that industry to the area concerned. The following data, compiled by the Dominion Bureau of Statistics, indicates the present importance of the Forest Industries to the economic life of the Province of Ontario:

	1937		1943	
	Wood and Paper	% of Total	Wood and Paper	% of Total
Total Number of Establishments	2,618	27	2,932	28
Capital Invested, \$ millions . . .	338	20	378	13
Employees, thousands . . . . .	56	17	69	12
Salaries and Wages, \$ millions . .	68	18	104	11
Cost of Materials, \$ millions . . .	99	10	164	7
Net Value of Products, \$ millions	123	15	195	11
Gross Value of Products, \$ mil- lions . . . . .	232	12	372	9

The purpose of research on utilization in the wood-using industries is two-fold:

1. To ascertain the manner in which the forest resources of the Province should be exploited so as to provide the greatest use-value in terms of value of production, employment of labour, etc., and to find the most suitable methods of using species of trees which now have little or no apparent value. The latter objective is really a form, and a most important one, of the conservation of our forest resources.
2. To develop techniques of manufacture and methods of eliminating waste so that the cost of the finished products of the industry will be such as to allow the industry to compete in the domestic and export markets. Ability to compete in export markets is the life-blood of the wood-using industries in Ontario and in Canada.

Many of the operations in converting wood into lumber, plywood, pulp, paper, rayon, plastics, chemical products and engineering materials are highly technical and scientific. This means that research must cover many fields of scientific endeavour such as chemistry, physics, biology, pathology, forestry, engineering, etc. This broad field cannot be covered by one or two agencies but requires the co-operative effort of many organizations.

Important technical advances have been made in the use of wood during the past twenty-five years and the recent war has hastened these developments. These advances, however, only result in emphasizing the unlimited possibilities in the use of wood as a raw material. Despite the considerable fund of knowledge already acquired, too little is yet known about this highly complex and variable material called wood. More and more intensive research is required.

In using the term "research" it is customary to consider two types or levels—firstly, basic research and secondly, industrial research.

The object of basic research is the searching out and the organizing of the fundamental facts concerning the materials used and the processes employed in using them, without direct reference to the commercial application of the results. Such work is usually done by university laboratories or by special institutions such as the Pulp and Paper Research Institute of Canada.

The object of industrial research is concerned with the finding and the developing of new processes of manufacture and of new products. Such work is usually done by government organizations such as the Forest Products Laboratory of the Dominion Forest Service, by specially endowed institutions such as the Ontario Research Foundation, by commercial laboratories and by industry itself.

In using these definitions, however, it must be kept in mind that no clear-cut dividing line can ever be drawn between those two levels of research. The distinction is mainly useful in determining the type of organization most suitable for conducting work in the various fields that are to be covered.

## **B. Research Now Being Done**

A tremendous amount of research on the utilization of wood is now being carried on by many agencies in Canada, in the United Kingdom, in a number of European countries, and particularly in the United States. In fact it might almost appear that there was a sufficiency of organizations already working on these problems. Such a conclusion, however, may not be warranted. In the first place, the field is so broad and the problems so diverse that many minds and many methods of attack will be required to produce the desired results. In the second place, many of these agencies are hampered by lack of sufficient staff and facilities to properly carry out their work.

In this connection it does appear that, while there is a considerable amount of research being carried on, there is a definite lack of a control organization, or organizations, where all relative information concerning these problems can be gathered together and made available to those interested. This situation may, and undoubtedly does, result in much duplication of effort on the part of research agencies on the one hand and the failure of industry to avail itself of the knowledge already gained on the other. The results achieved by basic scientific research are fairly generally distributed through various channels but the same cannot be said for the results of industrial research.

The following gives a brief summary of the major agencies now engaged on wood utilization research in Canada:

### **The Forest Products Laboratories of Canada**

This organization is operated and financed entirely by the Dominion Government through the Dominion Forest Service. The main laboratory is in Ottawa and a branch is maintained in British Columbia in association with the University of British Columbia. The work of the Forest Products Laboratories is concerned with problems relating to all of the Provinces of the Dominion.



The Laboratories are primarily concerned with investigations having to do with improvement of products or methods of manufacture, new uses for raw material and curtailment of waste in industry. This is largely industrial research although a certain amount of basic research must necessarily be done where the required data is lacking.

Investigations undertaken by the Laboratories are of several kinds. There are those of general interest which are initiated by the staff of the Laboratories or they may be suggested by industry. Secondly, there are those of more limited interest but which will be undertaken if the possible results would seem to justify the effort. Thirdly, there are those requested by a specific company or individual. In such cases a charge is made but little of this type of work is done. Finally, there is the co-operative investigation by the Laboratories and a wood-using industry, in which each share a portion of both the work and the expenses. Much valuable work of this character has been accomplished.

The type of problem investigated by the Laboratories includes Timber Mechanics, Containers, Plywoods and Veneers, Physics, Preservatives, Lumber Seasoning, Timber Pathology, Wood Paints, Wood Hydrolysis, Wood Plastics, Wood Distillation, Chemical Extracts, Wood Technology, Logging and Saw-milling, Secondary Industries, Economic Studies and Pulp and Paper. For a more complete list see IX. 3. a. (Ref. The Forest Products Laboratories Programme of Work, 1946-47.)

The Forest Products Laboratories are also in active co-operation with the Pulp and Paper Research Institute concerning matters relating to pulp and paper problems.

#### The Pulp and Paper Research Institute of Canada

This Institute is a co-operative effort on the part of the Dominion Government, McGill University and the Canadian Pulp and Paper Association, all three parties participating financially. The work of the Institute is under the control of a Joint Administrative Committee consisting of representatives of the three parties concerned. A laboratory is maintained in Montreal and many investigations are carried out at McGill University and at the Forest Products Laboratory in Ottawa.

The work of the Institute is primarily that of basic research on problems relating to pulp and paper, the application of the results obtained being left to industry itself. A certain amount of testing is done on behalf of individual companies for which a fee is charged. The Institute maintains a library and information service which is made available to industry.

Problems now under study by the Institute include Investigation of the Mechanical Pulping Process, Improvement of Testing Methods, Investigation of the Beating Process, Determination of Pulp Surface, Printing Studies and Analysis of Sulphite Waste Liquor. (Ref. The Forest Products Laboratories, Programme of Work 1946-47).

#### National Research Council

The National Research Council of the Dominion Government has not directly concerned itself with research on wood utilization or on forestry. Much of its work, however, is necessarily closely related to these fields and the fairly extensive facilities of its various divisions and laboratories can be of great assist-

ance to the wood-using industries. The Council also maintains an extensive library of basic scientific data which can be made available to all research workers.

Included among the problems relating to wood utilization on which the laboratories of the Council can give direct assistance are Hygroscopicity of Materials, Investigation of Strength of Materials, Examination of Wood Fibres, Use of Wood in Aircraft Construction, Plastics and Plastic Bonding of Wood, Preservation and Surface Protection of Wood, Rotproofing of Cellulose Materials, Packaging Research, Utilization of Agricultural and Forest Wastes by Chemical Conversions and Industrial Fermentations.

## Universities

### (a) University of Toronto

The greater part of the research directly relating to wood utilization presently carried on in the University of Toronto is that being done by the Department of Chemical Engineering.

Such investigation includes:

- (1) Study of the bonding of plywood with synthetic resins.
- (2) Study of the recovery and use of lignin and other materials from sulphite waste liquor.
- (3) Study of the possibility of obtaining new products from the distillation of wood.

(b) The other universities in Ontario are doing no direct basic research on wood utilization. This situation is mainly due to a lack of sufficient staff and facilities.

(c) It should be noted here that the universities would appear to be the logical organizations for the carrying on of basic, scientific research. Basic research, being the seeking after fundamental knowledge, requires a detached and long-range viewpoint unconcerned with immediate commercial results. The university laboratories are ideally suited for this purpose.

In the second place, the primary objective of the university is to educate. To do this properly requires not only adequate facilities and teaching staffs but also an atmosphere which encourages students to continue their studies after graduation and to become expert in their special fields of scientific endeavour. An active programme of research is essential to the attainment of this object. At the present time research work of every kind is greatly restricted owing to the lack of suitably trained men. The universities must provide the men required.

Owing to the fact that undergraduate teaching, graduate teaching and research are inextricably intermingled, these two functions can be discharged simultaneously if the conditions at the universities are suitable in this respect. This has been generally understood but the provision of these conditions has lagged behind the need. Physical facilities, while considerable, are not sufficient. Teaching staffs have been too few in number to allow such men to carry on research in addition to the heavy burden of administration and of regular teaching and laboratory work. Salaries paid to teaching staffs are generally inadequate. Finally, too little encouragement and financial assistance has been given to trained men to engage in post-graduate work although the provision of scholarships, fellowships and prizes by governments, industry and individuals has been of considerable help in this respect.

An excellent explanation of the place of universities in research has been given by D. L. Thomson, Dean of Graduate Studies and Professor of Biochemistry, McGill University, in an address presented to the Canadian Chemical Conference in Quebec on June 6th, 1945.

### Industrial Laboratories

All pulp and paper companies maintain laboratories for the technical control of production but, in addition, a number of these companies are engaged in industrial research as well. There has been an increasing tendency on the part of the pulp and paper companies in recent years to extend their staffs and facilities for industrial research and this movement will undoubtedly be continued.

Other industries using wood or its derivatives as a raw material such as in plywood, rayon, plastics and various products in which cellulose is a base maintain, in varying degrees, laboratories for industrial research.

Owing to the manner in which the lumber industry is organized practically no research is carried on by individual companies. The lumber industry and the related wood-working industry are composed of relatively small units which are unable individually to afford the cost involved in research. For this reason the industry has relied to a large extent on the Forest Products Laboratories and to some extent on the users of its products.

### Commercial Laboratories

There has apparently been no great development in this field in Canada. By commercial laboratories is meant a laboratory and technical service organized privately and maintained by the fees charged for work done.

### The Ontario Research Foundation

This Foundation was originally founded through the co-operation and financial assistance of both industrial concerns and the Provincial Government. Its purpose is to provide research facilities to both industry and agriculture in Ontario. As a result of the original endowments, such services can be provided for fees which cover only the direct operating cost involved.

Any company or organization in Ontario may ask the Foundation to work on a research project on their behalf. If the project appears to have merit and if the necessary facilities are available, the work will be undertaken, with the applicant bearing the direct cost involved. In these cases, the results of this research become the property of such company or organizations. The Foundation does a certain amount of independent work that is exclusive of these definite arrangements with specific industries but lack of staff and funds has restricted this type of work.

It should be said that the Foundation is providing invaluable assistance to industry and agriculture in the Province. The further possible development of this organization is covered later in the section on Recommendations.

### Foreign Agencies

A vast amount of research on wood utilization is carried out in many other countries including the United States, the United Kingdom, Sweden, Finland, Russia, Australia and New Zealand. It is well-known that Germany had made great strides in wood research prior to the war.



The United States has been particularly active in this field and the work of the Forest Products Laboratories of the United States Forest Service has been outstanding. In addition, this work is being carried on by other Federal and State organizations, by universities, by industrial associations, by private companies, by private institutions and by commercial laboratories. (Ref. "Forest Products Research Guide" by the American Forest Products Industries, December 1945.)

It is interesting to note here that, at a recent conference on State and Federal Forest Products Research, the groundwork was laid for a permanent organization of research scientists, technicians and wood-using industries. The purpose of this organization is to collect information on forest products research, to distribute this information among those interested, and to act generally as a clearing-house for all agencies and individuals working in this field.

### C. Suggested Fields for Further Work or New Projects

It is difficult if not impossible to make definite suggestions with regard to the actual problems which should be studied. The field is so vast, the possibilities so great and the knowledge still to be gained so varied and extensive that it is only guesswork to predict what avenues will give the greatest results. It can safely be said, however, that all present endeavours along these lines must be encouraged, facilitated and extended.

This problem is particularly difficult in connection with basic research. Here results will largely be achieved by the research worker acting in accordance with his own ideas and hopes. These results may be valuable or worthless but they cannot be predicted. Too much direction or organization in this field is not recommended. The problem may be briefly stated by saying that more knowledge is required about the chemical and physical properties of the various species of wood.

In connection with industrial research the problem is somewhat clearer in that industry, which hopes to benefit by the results achieved, has some idea of what it wants. The methods to be followed in attacking the problem, however, may be unknown and the solution may come from unexpected sources.

It might be noted here, however, that developments during the recent war have shown that results can be achieved when research workers are given specific problems to solve. This has been evident in the great advances made in the packaging of materials, the construction of wooden containers, the use of wood in aircraft and boats, the construction of timber buildings, the use of cellulose in explosives and in many other lines.

The following are a few of the major problems which appear to require a solution:

#### Lumber

The utilization of the waste now produced in logging, milling and wood-working operations. This is all-important. It is estimated that well over 50% of the tree volume is wasted.

More engineering data on the use of timber in construction.

Better methods for seasoning lumber.

Chemical treatment of lumber with a view to improving its qualities with respect to hardness, strength, shrinkage, decay and fire resistance.

## Plywood

- Improvement of binding techniques.
- Improvement in glues and adhesives.
- The possibility of using lower grades of timber.

## Chemical Products

The possibilities of the development of a chemical industry based on wood as a raw material should be further examined. Such products now include alcohol, yeast, lubricants, charcoal, producer gas and many other materials.

## Pulp and Paper

The utilization of the waste liquor now produced in the pulping process.  
The use of species of wood not now considered suitable for the manufacture of pulp.

The use in the manufacture of pulp of the waste remaining from sawmilling and wood-working operations.

The improvement and standardization of methods of testing the qualities of pulp and paper.

Further basic research on the characteristics of cellulose, lignin and the other component parts of wood.

For a more detailed list of research problems in the pulp and paper industry see IX. 3. 6 (The Forest Products Laboratory Programme of Work, 1946-47).  
(i) Regeneration Survey.

## D. Recommendations

It is difficult to make specific recommendations covering such a broad field and it is particularly difficult to suggest the obligation that should be assumed by one province. This is primarily a nation-wide problem and yet each province is vitally interested through its ownership and control of the majority of the forest-producing lands. Furthermore, every province must assume some responsibility for the well-being of industry within its borders. It is a known fact that the Province of Ontario, and the other provinces as well, derives a considerably higher direct income from its forests than is spent on the administration, protection and improvement of these forests. Owing to the great importance of the forest industries to the welfare of the Province, greater expenditures could profitably be made on the forests and this should include expenditures on forest and wood utilization research.

In making the following recommendations it has been kept in mind that this is both a national and a provincial problem. It appears to be desirable that there should be some machinery for a greater co-ordination of effort and an exchange of information on a nation-wide basis but it has not been considered that an examination of such Dominion-Provincial relations was to be a part of this report. It is felt, however, that any steps that might be taken by the Province of Ontario to carry out these recommendations would in no way interfere with, and would satisfactorily fit in with, any steps that might be taken later on a broader basis.

### **It is therefore recommended:**

1. That the Board of Governors of the provincial universities be requested to submit a report on their requirements for additional staff and facilities necessary for the proper carrying out of an adequate programme of basic research on the utilization of wood and that, on the receipt of such reports, steps be taken to provide the funds necessary for the carrying out of these programmes.
2. That a Director of the Ontario Research Foundation be requested to submit a report on the requirements for additional staff and facilities necessary to provide:
  - (a) Expanded facilities in the Foundation so that a broader and more adequate service may be provided to industry in Ontario.
  - (b) Sufficient facilities and staff so that the Foundation may carry out desirable research endeavours independent of those requested by specific industries.

And that, on the receipt of such report, steps be taken to provide the necessary funds.

And that the facilities offered by the Foundation be more widely advertised among the industries in the Province.

3. That steps be taken to encourage industrial associations and private companies in the Province to provide more funds for fellowships, scholarships and prizes for the purpose of encouraging and assisting students who desire to continue in graduate studies and research work.
4. That the Province of Ontario establish an "economics research" or "intelligence" organization having as its primary purpose the collection, organization, and distribution of all available knowledge concerning forestry and forest-products research. The information to be collected by this organization should not be confined to scientific data only but should include all information relating to the economics of the forest products industry. Such an organization could be invaluable as a source of information to industry and to research workers generally. There is a definite lack of such a source at the present time.

Of equal importance is the fact that this organization would be in a position to advise the Government on all matters relating to research and it should be empowered to initiate such investigations as may seem desirable and to report the results to the proper authorities.

It is conceivable that such an organization might be set up to cover the needs of all industries and of all research in the Province. In this event, it is strongly recommended that a separate division covering the forest industries alone be provided as this single field is of a size and importance to warrant such treatment.

Finally, the direction of such an organization must be placed in extremely competent hands which will be capable of combining both the scientific and economic aspects of the problems that will be encountered.



## THE GENERAL FIELD OF RESEARCH OF THE FOREST PRODUCTS LABORATORIES

The following is intended to indicate the types of research carried out in the Forest Products Laboratories. More detailed information is available in the 1946-47 Programme of Work of the Laboratories.

### Types of Work

**Timber Mechanics**—Physical properties of different species; mechanical properties of large structural timbers; standards for use in grading structural timbers; timber fabrication for housing and heavy structures; structural assemblies; laminated constructions.

**Containers**—The design and testing of containers for shipment of export commodities (wood, fibreboard, plywood, paper, etc.); the setting up of standards of design and performance; collaboration with the Canadian packaging Committee; the Canadian Standards Association, Government Departments and industry.

**Plywoods and Veneers**—Technical problems in veneer and plywood manufacture; adhesives and adhesion problems; the operation of a pilot plywood plant for work on different species and processes; industrial applications of plywood; utilization of waste in veneer plants.

**Physics**—The application of physics to methods of testing and to procedures; the development of new techniques and new technical equipment; the application of infra-red and electronic heating to problems of drying, adhesion, and veneers and plywood moulding.

**Wood Preservation**—The preservative treatment of timber with toxic chemicals; new preservatives, their effect on fungi, insects and marine organisms; methods of application of preservatives (pressure or non-pressure); the operation of a pilot scale wood preservation plant; long-term durability tests of preservatives; service records of treated timber in structures; plant control and control instruments and equipment; the application of fire-retardant chemicals and paints; wood paints in the maintenance of wood structures.

**Timber Pathology**—The investigation of the organisms causing decay, staining and moulding of wood; the significance of such organisms in the service life and marketing of the timbers; methods of preventing the development of such organisms; the control of slime in pulp and paper mills.

**Wood Hydrolysis**—The production of wood sugars from wood waste (sawdust, shavings, edgings, etc.) by Scholler, Bergius, and other processes; the fermentation of wood sugars for the production of ethyl alcohol and other products; the utilization of the lignin of wood hydrolysis; the development of useful chemicals from wood waste by electro-chemical and micro-biological processes.

**Wood Plastics**—The investigation of new commercial adhesives and the laboratory development of special adhesives; the use of wood flour and lignin in plastics; the formulation and application of compregnated and other improved woods; the manufacture of various kinds of boards from wood paste with or without binders. Industrial application of wood plastics.

**Wood Distillation**—The manufacture of kiln and retort charcoal with and without recovery of by-products; destructive distillation of softwoods for recovery of pine tar, pine oil, etc.; steam and solvent distillation of softwoods; charcoal briquetting; metallurgical charcoal; activated carbon.

**Chemical Extracts and Miscellaneous**—Canada balsam; spruce gum; cedar leaf oils; pine needle oils; tannins; utilization of wood bark; insulating board.

**Logging and Milling**—Logging practices and equipment; the utilization of logging waste; sawmill practices and equipment, the economics of operation; the utilization of sawdust and other sawmill waste; lumber grading and standards.

**Secondary Wood-using Industries**—Planing mill practice and equipment; the manufacture of small dimension stock; pre-fabrication in housing and other structures; the relation of Building Codes to mill products; techniques in furniture manufacture; small woodenware industries as users of mill waste; exhibits.

**Economic Studies**—Integration of wood-using industries for more efficient utilization; silvicultural relations; trends in wood utilization; co-operation with industries and provinces in developing new techniques.

**Lumber Seasoning**—Factors controlling the efficiency of natural air-seasoning in different areas; design, operation and equipment control in dry-kilns; the seasoning of wood with chemicals; the control of moisture and temperature in wood-bending; vapour drying; degrade in lumber seasoning; moisture control for domestic and export shipments; moisture control in manufacturing and fabricating plants.

**Pulp and Paper**—Techniques in the manufacture of mechanical and chemical pulps; methods of testing pulps, and equipment for making tests; techniques in the manufacture of newsprint and other classes of paper, pulp-board, etc.; the utilization of waste pulp liquors; standardization of testing equipment; the utilization of waste wood for pulp and board; the utilization of bark; printing qualities of paper; methods and equipment for testing printing qualities; the utilization of cellulose, lignin and other wood constituents.

**Wood Technology**—The structure of different wood species and of foreign competing species; wood identification (microscopic, photo-micrographic, etc.); properties in relation to uses for specific purposes; variation in density and other properties within a species; the significance of compression wood; defects and their significance; chemical treatment for bark removal.

### Methods of Operation

Investigations undertaken by the Forest Products Laboratories are of several kinds:

- (1) **Investigations of general interest.** These may be initiated by the Laboratories or they may be suggested by an association or group in the wood-using industries. They are financed out of government appropriations to the Laboratories.
- (2) **Investigations of limited interest.** These problems are generally suggested by a particular industry or even a company or individual. If it is decided that the problem is one which promises possibilities of

improving an existing situation or adding new and useful information to the wood-using industry it may be undertaken.

- (3) **Special investigations for particular companies or individuals.** This refers to investigations where reports of results are for the sole use of the company or individual requesting the work. Only a very limited amount of such work is carried out. When it is undertaken a charge is made to cover direct outlay for salaries, materials, etc., and an additional charge is included to cover overhead.
- (4) **Co-operative investigations**—A good deal of co-operative work is carried out with wood-using organizations. Many of these supply, at considerable expense, materials for the study and often additional technical assistance or labour. If it is decided that the proposed work is of value, the first question to be decided is whether the work is to be considered confidential in character. If it is not then the work may be undertaken by the Laboratories on the understanding that the Laboratories are quite free to publish the results of the investigation for the benefit of any who may be interested. Much valuable work of this character has been carried out through co-operation with lumber associations, government departments, public utility organizations and other organized bodies.

### Types of Work

The Laboratories are primarily concerned with investigations having to do with improvement of products or of methods of manufacture, new uses for raw material and curtailment of waste in industry. This would suggest that the Laboratories are concerned principally with research which is largely industrial in character and this is the case up to a point. In carrying out an investigation which is primarily industrial in character, difficulty is very frequently encountered through lack of scientific or basic data required in the solution of the problem. For this reason a good deal of basic research is carried out.



## A CONSIDERATION OF CERTAIN FACTORS AFFECTING THE TECHNICAL AND ECONOMIC POSITION OF PULP AND PAPER MILLS IN ONTARIO

A number of processes for the conversion of wood to pulp have been evolved over the years, each of these being particularly adapted to a certain wood species, or group of species, and each resulting in pulps of a type best adapted to a limited and specific group of end-uses. However, with improved techniques the properties of some of these pulps may be modified so that they are equal to, or even better than other pulps previously considered essential for certain products. The chemicals, steam and power required in conversion, and the yields of pulp and by-products are in each case somewhat different. Thus the manufacturer or prospective manufacturer is faced with extremely complex technical and economic problems in logically planning future developments in this field. Illustrating some of the points the accompanying chart shows the principal pulping processes, together with an indication of some of the various factors that enter into the economics of their manufacture. This chart is self-explanatory and will not be elaborated in the text.

At the present time the mills manufacturing chemical pulps in Ontario can be divided into two groups.

1. The older mills, using the sulfite process, these being largely located in southern and eastern Ontario, thus being a considerable distance from their wood supply, although relatively close to markets.
2. The newer mills, including those now being built, designed for use of the sulphate (kraft) process, these being largely located in western and northern Ontario, thus being close to their wood supply although at a distance from markets.

Generally a paper mill is located adjacent to a pulp mill which supplies at least a reasonable proportion of its fibrous raw material and such is found to be the case in most of the larger Ontario mills. In many of the older mills much of the equipment in either the pulp mill or the paper mill is approaching the stage of obsolescence. In both types of mill such obsolescence will result from the normal wear and tear coupled with the fact that equipment of modern design will give a greater production per unit of labour. In the older pulp mills the competitive position may at the same time be adversely affected by the high freight costs involved in bringing wood from a continually more distant area. When it is considered that a single paper machine of medium size will cost approximately a million dollars, it will be seen that the decision as to whether or not to modernize an apparently unfavourably situated mill cannot be taken lightly.

What are the factors which can improve the economic status of mills located in the more settled portions of the Province? First may be considered the development of by-products such as alcohol and yeast from the wood-sugars, plastics, and chemicals such as vanillin from the lignin, and products, yet to be established, from the bark. As the yield of saleable products per unit of wood increases, the advantage of proximity to markets approaches that of proximity to raw material. If through the development of by-products the economic position of mills regardless of zone becomes more nearly equalized a more stable industry may be attained.

Barked Logs

Chips

	Chemical Pulps			Semi-Chemical			Mechanical		
	Sulfate (Kraft)	Soda	Sulfite	Acid Sulfite	Neutral Sulfite	Steam Exploded	Asplund	Ground-wood	
Wood—Referred Species.	Spruce, Balsam and other soft woods.	Poplar and other hard woods.	Spruce, Balsam, Hemlock.		Poplar and other hard woods.	Soft woods (scrap wood).	Coniferous	Coniferous.	
Wood—Occasionally Used Species.	Hard woods	Soft woods.	Hard woods.				Poplar	Poplar.	
Digestion Chemicals, lb/ton Pulp.	Salt cake (250-300 lb.).	Caustic Soda (80-150 lb.).	Sulfur Limestone (200-300 lb.). Limestone (300-350 lb.).	Sulfur (200-300 lb.). Limestone (300-350 lb.).	Sulfur (150-300 lb.). Soda Ash (150-300 lb.).				
Bleaching Chemicals.	Chlorine, Lime Caustic, Soda.	Chlorine, Lime, Caustic, Soda.	Chlorine, Lime, Caustic, Soda.	Not bleached.	Chlorine, Lime, Caustic, Soda.	Not bleached.	Not bleached.	Hydrogen Peroxide.	
Approximate Pulp Yield.	45-50%.	45-50%.	45-50%.	60-65%.	60-85%.	85-90%.	90%.	95%.	
By-products lb/ton Pulp.	(C. Steam 12,000 lb.). R. Lignin (500-600 lb.). C. Commercial (300-400 lb.). C. Commercial use in plastics.	C. Steam 12,000 lb. L.C. Lignin (300-400 lb.). Used in plastics.	P.P. Steam (12,000 lb.). L.C. Vanillin (60-80 lb.). L.C. Alcohol (40-60 gal.). Road binder. Yeast.						
Chief Fibre Characteristics.	Excellent strength.	Good opacity and high bulk; medium strength.	Light coloured unbleached pulp; good strength; easy hydrating; suitable for conversion to rayon, etc.	Newsprint.	Good strength; Easy Hydrating.	Low strength unless bonded in hydraulic press.	High bulk, low strength, unless bonded in hydraulic press.	Low strength; good printing qualities; low colour.	
Major Pulp Uses, unbleached.	Wrapping papers, corrugating papers, building papers.	Newsprint, Box-board.	Newsprint.	Newsprint.	Book paper, Glassine.	Hardboard.	Roofing-felt, Hardboard.	Newsprint, Insulating wallboard.	
Major Pulp Uses, bleached.	Bonds and printing papers.	Book paper; mimeograph; blotting.	Bond book paper; Glassine. Rayon.	Book paper, Glassine.				Book paper.	
Present Status of Industry.	Relatively low production costs, versatility with regard to wood and good strength make this attractive process for present new installations. Very rapid expansion now under way.	Long established process "for specialty" pulp used in relatively small quantities. Little expansion visualized.	Long established and important process. Little expansion at present time. Full commercial development of "waste sulfite liquor" utilization should result in considerable stimulus to industry.	Modification of normal sulfite process to give higher yield for newsprint.	Largely in experimental stages. Because of high yield and good strength from deciduous wood, process should become increasingly important.	Demand for structural fiberboard should result in increased production of Masonite type products.	Process used for specialized purposes such as roofing felt, building board, etc.	Long established process for newsprint. Recent development of bleached groundwood printing papers should result in expansion of industry.	





Another factor which should be considered is the greater utilization of hard-woods including fast growing species such as the hybrid poplar. Trees of this type should be available from farm wood lots on a continuing crop basis. An efficient reforestation programme for the farmers would also have obvious advantages from the standpoint of soil conservation and flood control. The commercial utilization of such species is at present extremely limited but laboratory work has indicated that the so-called semi-chemical hard-wood pulps may have properties which compare favourably with those of the pulps from spruce. Considerable research directed towards economy in processing and also with regard to the quality obtainable from the fast growing hybrid species is required before any wide spread development can be expected.

Unless or until the mills of southern and eastern Ontario can feel assured of a favourable economic position, long range planned improvement is likely to be delayed or neglected with the result that their condition may deteriorate to the point where they will be forced to close as has been the case with several American mills.

This brief survey has outlined some of the factors which may influence future trends in the industry. Co-ordination of these trends and definition of the ends that may be attained can have a profound influence on the future of the industry and through it on the prosperity of the Province.

# FOREST RESEARCH—DEPARTMENT OF LANDS AND FORESTS

## GENERAL PROBLEM

### I. Regeneration

#### (a) Natural

- (i) **Regeneration Survey.** This survey is being carried out on burned and cut over areas of different ages and sites throughout the Province of Ontario to determine present stocking and to study those factors favourable or detrimental to the establishment and survival of regeneration, e.g., seed supply, seed bed condition, soil moisture, exposure, etc. This survey should, where possible, give consideration to developing a simple method of site identification on cut over areas so that site classification may be carried on. Also an attempt should be made to determine the natural successions of plant communities on different sites, the stage in succession producing the most economically valuable community and the factors affecting its establishment.
- (ii) It is believed that certain logging methods are unfavourable to regeneration and, although a great deal of basic information on this subject is still lacking, it seems probable that for some species a modification of present logging methods would result in more satisfactory regeneration. More specifically, studies should be made on the occurrence of seed years for the more important commercial species and to determine the possibilities of modifying present logging methods with the object of minimizing damage to advance growth and the creation of favourable seed bed conditions. It is recommended that the surveys on forest regeneration be continued in Ontario similar to the ones being carried out by the Dominion Forest Service in other provinces.
- (iii) Since insects and other destructive agents are known in some cases to destroy a large percentage of the seedlings produced under natural conditions, some estimate of their importance in various forest environments would be necessary in a survey of this sort.

#### (b) Artificial

Artificial regeneration may be carried out on recently cut over or burned areas, on areas where competitive growth is well established and on open land sub-marginal for agriculture where the possibilities of planting machines may be developed. The following are some of the main specific problems that should be studied under this general heading:

- (1) Large-scale collection of seed (methods and procedures).
- (2) Determination of site quality.
- (3) Preparation of site, methods and time for planting or sowing.
- (4) Seed treatment to increase survival of seedlings.
- (5) Development of superior strains of economic species.

## **II. Protection**

### **(a) Fire**

- (a) Investigation of actual and allowable forest losses in Ontario; allowable loss to be defined as loss whose prevention-costs exceed the values saved.
- (2) Investigations to improve fire prevention equipment including (a) lookout towers and equipment and (b) aircraft.
- (3) Investigations to improve fire suppression equipment including (a) pumps, hose and nozzles, etc. (b) fire line construction machines (c) special vehicles and aircraft.
- (4) Investigations on fire weather forecasting in forest protection should be undertaken in Ontario along the lines of the work already done by the Dominion Forest Service in New Brunswick, Quebec, Saskatchewan and the National Parks of Canada.

### **(b) Biological**

- (1) Investigation of white pine blister rust.
- (2) Investigation of red stain and butt rot in jack pine.
- (3) Investigations of cone destroying insects.
- (4) Investigations of heart rot of poplar.
- (5) Investigation of insecticidal spraying by aircraft and from the ground.

### **(c) General**

- (1) Investigations of smelter fume damage to white and red pine.

## **III. Surveying**

- (a) Investigation of radar methods "Shoran", etc., to provide ground control for aerial surveys.
- (b) Development of specialized photo interpretive equipment for forest type mapping.
- (c) Investigation of special films for forest type mapping.
- (d) Establishment of survey photographic library at some central point in Ontario to include all Ontario survey photo prints.
- (e) Studies to integrate more effectively aerial and ground survey information.

## **IV. Utilization**

- (a) Investigation into the possibilities of encouraging the co-operation and co-ordination of the activities of the several branches of the wood-using industries with a view to assuring the best economic use of the whole product of the forest.
- (b) Investigation into the possibilities of improving sawmill practice. It is known that many sawmills, especially among the smaller units, use practices which result in a great deal of waste and which may not be making the best use of their raw material. Such a study should give consideration to European practices and their practicability in Canada.



- (c) Chemical Utilization—Wood has been extensively used for chemical pulp and in wood distillation. Otherwise its use as a raw material for chemical products has received insufficient attention. In view of the very large amounts of waste in both mills and in the woods, much greater attention is required to processing it by hydrolysis, microbiological action and other such means. Much greater attention is also required to the study of lignin and cellulose derivatives. Universities should be encouraged to do basic work in this field and to supply trained workers to supplement the staffs and organizations already engaged in this type of work.
- (d) Investigations into possible methods of utilizing the waste resulting from logging operations. Such an investigation should include both a study of possible uses for this material and a study of the transportation and other extractive problems involved.
- (e) Utilization of Poplar—Interest in the use of poplar is widespread but nothing in published form is available for the use of owners of poplar stands. Its use for lumber, pulp and plywood is increasing. Steps should be taken to assemble and publish as soon as possible up-to-date information on this subject. A knowledge as to the potentiality of hybrid poplar species from the standpoint of their adaptability for various uses as well as their value in reforestation of marginal agricultural lands is also required.
- (f) Red Stain in Jack Pine—Studies should be carried out on the utilization of this stained material by co-operation with organizations which already have this matter in hand.
- (g) Selection and preservation of mine timber.

## V. Forests and Water Supply

Investigation of the relation between forest cover and water supply, surface and subsurface. Study of data secured and reports prepared in Canada and elsewhere. Initiation of collection and study of pertinent field data in specific areas of the Province, including precipitation, stream flow, subsurface storage, soils, and forest cover.

## VI. Research and Training of Research Personnel

Present facilities for research and for training research personnel at the graduate level are entirely inadequate for research and for the supply of men to carry out the projects contemplated by various Government agencies. Greatly increased facilities for research and for the training of such men by the universities concerned are therefore urgently needed in various phases of forest biology. If the universities are unable to take the steps necessary for the training of these men, direct action by the Commission to provide the necessary space and facilities is suggested.

### RECOMMENDED PROJECTS—FORSTRY RESEARCH—1947-48

Title	Agency	Capital	Operating	Total
Wood Chemistry	Ontario Research Foundation	\$2,000.00	\$18,000.00	\$20,000.00
Forest Regeneration and Management in Woodlots and Rocky Regions	Queen's University		1,590.00	1,590.00
Unclassified as yet (for Sawmill practice research)				25,000.00
		<u>\$2,000.00</u>	<u>\$19,590.00</u>	<u>\$46,590.00</u>

## COMMITTEE ON AGRICULTURAL RESEARCH

### Meetings—

Informal.....	July 9th, 1946—	Ontario Agricultural College
	July 10th, 1946—	With Ontario Research Commission
Advisory Committee.....	Sept. 9th, 1946—	Ontario Agricultural College
" " " "	Dec. 16th, 1946—	" " " "

### Committee—

Mr. K. Betzner.....	Kitchener, Ont.
Mr. Gordon Blair.....	Niagara Spray Co., Burlington
Dr. H. D. Branion.....	Ontario Agricultural College
Professor C. G. E. Downing.....	Ontario Agricultural College
Professor E. H. Garrard.....	Ontario Agricultural College
Dr. E. S. Hopkins.....	Central Experimental Farm, Ottawa
Mr. L. Kerr.....	Chatham, Ont.
Professor R. G. Knox.....	Ontario Agricultural College
Mr. C. F. Luckham.....	St. Williams
Dr. A. L. MacNabb.....	Ontario Veterinary College
Mr. M. H. McCurdy.....	Cockshutt Plow Co., Brantford
Dr. G. P. McRostie.....	Ontario Agricultural College
Mr. E. F. Palmer.....	Horticultural Experiment Stn., Vineland
Mr. K. Neatby.....	Department of Agriculture, Ottawa
Mr. Arnold Pitt.....	Massey-Harris Limited
Mr. F. W. Presant.....	Toronto Elevators Limited
Professor C. N. Ruhnke.....	Ontario Agricultural College
Mr. G. Schell.....	Canada Packers Limited
Mr. J. C. Steckley.....	Experimental Farm, Ridgetown
Mr. W. G. Toner.....	Royal Dairy Products, Guelph
Mr. S. B. Trainer.....	Silverwoods Dairy
Mr. George Wilson.....	Department of Agriculture, Ontario
Mr. S. M. Young.....	International Harvester

# BRIEF OF THE ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH TO THE ONTARIO RESEARCH COMMISSION

## 1. INTRODUCTION

Research in agriculture is so well-established, and has made such significant contributions to the welfare of the Dominion and of the Province, that no justification of a research programme is required. No one can live in any part of Canada for even a short time without being made aware of the tremendous ramifications of agricultural research, and no one questions its place in the greatest of Canada's primary industries. While the achievements are probably less spectacular than those possible in other fields, and may be the results of tedious years of rather dreary investigations, nevertheless, the value to the community is so great that there is a universal desire to maintain the present agencies for research, and probably quite general endorsement of a reasonable extension of their activities. People remember what the breeding of Marquis wheat meant in the development of the West, and appreciate what the new rust-resistant cereal crops mean and will mean to the Dominion. Similar significant accomplishments have made the work of the fruit-grower, the tobacco-farmer, the bee-keeper, the stock-breeder, the dairyman—in short, all those engaged in agricultural production—much easier and much more profitable. In fact, the improvements in methods and standards of production directly attributable to research and extension have so altered agriculture that the changes effected may best be described as “revolutionary”.

### Co-ordination

Despite the fact that there is a multiplicity of agencies engaged in agricultural research, there has been surprisingly little conflict or outright duplication of effort. It is true that research on a particular problem may have commanded the attention of several agencies at one time, but the avenues to be explored were many, and, through the exchange of information, surprisingly little duplication occurred. This co-ordination of effort by the Dominion Department of Agriculture, the Provincial Departments of Agriculture, the universities and colleges, the research foundations and the National Research Council, has been evident in all branches and at all levels, and has been carried out through advisory and associate committees, through frank and complete exchange of information and through a general division of the work.

### Beginnings of Research

Immediately after Confederation the Dominion Parliament embarked on a regular programme of agricultural service, and within twenty years had set up numerous divisions, each charged with the responsibility for research and extension in a particular field. During the same period provincial programmes of research and extension were developing just as rapidly and just as efficiently. For the most part, the provinces worked through the provincial universities, colleges and foundations, through agricultural representatives and through producers' organizations or individual producers. The work accomplished over the years has won for provincial Departments of Agriculture and their associates prestige and prominence equivalent to that enjoyed in the industry by the Dominion Department of Agriculture, and, while it is impossible to enumerate



the contributions made, it should be pointed out that those contributions were particularly important in the fields of soils problems, crop production, animal production and the marketing of farm products.

### **Special Feature of Agricultural Research**

The notable feature in agricultural research, a feature which sets it more or less apart from research in other fields, is that activity commonly known as extension work, which must be an integral part of practically every project. Since knowledge gained in the laboratory, the college plot or the experimental farm is of value only when made known to the "practical farmer", and since the vast majority of these are rugged individualists, the agencies interested in agricultural welfare and progress must carry on their extension work constantly.

### **Types of Research**

Agricultural research, to be worthwhile, must cover the basic needs of production and of utilization. Research on production is well-established, and existing facilities, with some expansion, are competent to meet any likely problem in this field, which includes soils surveys and proper land-use, plant production and improvement and animal production and improvement, each with its host of related topics and its extension programme. Far less attention has been paid to utilization. Of late years the needs in this field have been recognized and some start has been made on an overall programme. It is recognized that the Dominion Government has a primary responsibility in this field, and is much better-equipped to promote the proposed campaign, but considerable contribution might be made by the Province. The importance to any industry of the utilization of its products requires no elaboration, and since agricultural production represents the work of hundreds of thousands of individuals, research leading to the maintenance of markets for that production must, of necessity, be a public responsibility. That research, which must be a major effort, includes the whole problem of markets with all the ramifications of world-trade problems, facilities for marketing, transportation, processing, industrial utilization of farm products and nutrition. It includes, as well, research on land-settlement, farm credits, stabilized prices, farm labour, together with consideration of farm amenities and cultural activities. Agriculture, to be permanently progressive and remuneratively attractive, must be efficiently productive in regard to both quality and quantity of its products. It follows, surely, that agricultural research must have continuity and must be attractive to qualified personnel.

## **2. GENERAL STATEMENT**

The Advisory Committee on Agricultural Research has received reports of the four Sub-Committees appointed to explore the status of agricultural research in Ontario. Copies of these reports have been submitted. The Committee has reached the following general conclusions with respect to the work which has been done so far by the Sub-Committees.

- (1) These reports do not present a complete inventory of the research under way by the several departments involved. Such a statement would be voluminous, and it has not been found desirable to request already overburdened staffs to prepare such material. Copies of the reports submitted at the July meeting at the Ontario Agricultural College are on file with the Ontario Research Commission.

- (2) These reports do not present lists of all the new projects which agricultural research officers feel should be undertaken. The establishment of such lists with indications of the relative urgency with which various projects should be undertaken would involve consultations on the part of many groups of specialists, and an over-all appraisal of the relative importance of each, which the main Committee does not feel competent to undertake.
- (3) Reports of the Sub-Committees have presented a cross section in the field of agricultural research in Ontario from which the Committee has been able to form an expression of opinion on the relative importance of the general lines of work under way, and the need for increased support to certain fields which have not received adequate attention or in which new possibilities have become apparent because of recent advances in science. While certain projects have been indicated as having high priority, this does not mean that other projects not so emphasized should not continue where facilities and personnel are available.

### 3. SUMMARY OF FINDINGS OF SUB-COMMITTEES

The main Committee presents the following general summary of the findings of the four Sub-Committees and the discussions in the main Committee:

#### SOILS RESEARCH

The basis of profitable farming is soil fertility. The store of fertility accumulated over centuries of weathering and plant and animal decay is becoming depleted through use and neglect. No field of research is more important to Ontario agriculture. For details of the type of research which are presently under investigation see Appendix "F", part of Appendices "D" and "E", and Appendix "G" to the report of the meeting of July 10th at the Ontario Agricultural College. For details of the field of Soil Microbiology see pages 6 to 11 of Appendix "B", the report of the Sub-Committee on Animal Husbandry, Soils, Plant and Animal Diseases, Field Husbandry and Animal Nutrition. The Committee also has reviewed the brief of the Advisory Committee on Soils Research. It will be observed that the projects which relate to agriculture in the report of the Advisory Committee on Soils Research are also stressed in this report.

#### (a) Surveys

Soil surveys are presently under way and must be all-inclusive, namely: typing, mapping and, of more immediate practical value, testing for suitability and requirements of various crops. These surveys should be continued and expanded. They are all important to a sound agriculture.

#### (b) Conservation

Much more extensive research is needed in all the fields which contribute to the establishment of a sound soil conservation programme for the Province. A continuation of the farm planning service and of the studies of erosion and runoff needs marked expansion.

### (c) Microbiology

It is recommended that more fundamental studies be initiated in the field of microbiology. It is increasingly evident that the active stages of decomposition of green manuring crops are at least partly responsible for satisfactory crop growth and fruitfulness. Crops respond variously to varying soil treatments. The physical and microbiological condition of soils needs to be studied intensively in relation to crop performance, incidence of disease, permanence of soil use. More fundamental knowledge would eliminate many costly trial and error experiments. Results of pot and greenhouse experiments of the past have been helpful, but we suggest future work should be planned to include co-ordinated, wider and more practical lines of research in microbiology. The need for such investigations is recognized and they are being initiated.

### (d) Structure and Fertility

It is recommended that further study be given to the fundamental problem of soil structure as influenced by tillage, by crop residues and the application of fertilizers.

The profitable use of fertilizers for various crops and on different soils and the best forms of fertilizer needs much study both for use on different soil types and in various parts of the Province.

The problems presently under investigation are of both fundamental and practical natures and should be continued. In fact, the suggestions, outlined above, are, in effect, an expansion of these studies.

### (e) Tillage and Machinery

Tillage machinery, when used, has a distinct effect on the physical structure of the soil. This structure and tilth may be further affected by rotation of crops, drainage and other physical cultural factors. Limited experimentation has been conducted on standard implements and cultural practices. Research must be instigated to evaluate introductory types of equipment, the effect of speed, depth and application of any machines on the required conditions of the soil for various types of crops.

## PLANT PRODUCTION

Plants transform the raw materials of the soil and air into food for domestic animals, poultry and man. The story of the steady advancement of agriculture has been that of constant diversification in the production of plants, their protection against disease and pests and their increased utilization by man for food, clothing and feeding of domestic animals. This process is still going on, intensified by the wearing out of soils, the increase of disease and pests which attack plants forced beyond their natural conditions of growth, and the necessity for economic production in a commercialized agriculture. The maintenance of an adequate research programme in plant production is, therefore, essential in Ontario. For details of the type of research presently under investigation see Appendices "A", "B", "C", part of "D" and "E", "I", "J", "K", "L" and "M" and part of Appendix "S" to the report of the meeting July 10th at the Ontario Agricultural College.\*

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\*Copies on file at—

- (1) Ontario Research Commission, 43 Queen's Park.
- (2) Legislative Library, Parliament Bldgs., Queen's Park.
- (3) Library, Ontario Agricultural College, Guelph.



### **(a) Breeding and Variety Testing**

Extensive enlargement of the field of plant breeding as applied to general farm crops, to pasture crops, and to many of the horticultural and specialty crops is most necessary. The breeding programme being conducted at present is quite extensive with winter wheat, oats, soybeans, field beans, barley, potatoes, and some fifteen species of grasses and legumes. Limited breeding is being done with practically all other types of field crops commonly grown in Ontario. Comprehensive breeding and variety trials of fruits and vegetables and some specialty crops are being conducted. In all such work consideration must be given to disease resistance, yield, quality, hardiness, market acceptability, etcetera. The nutritive value of the crops, either for animal or human consumption, is and must be given due consideration.

### **(b) Nutrition**

The nutrition of plants embraces many other fields of research such as soils, fertilizers, cultural practices, climatology and so on. In this broad field, continuation of and expansion, when possible, of the research in these various phases, will contribute to the knowledge of plant nutritive requirements. However, only a limited amount of work is being carried on in the specialized field of determination of the exact plant nutrient requirements and their interrelationships, as well as the specific requirements of some specialized crops. This fundamental field could be expanded advantageously.

### **(c) Cultural Studies**

The culture of farm crops, horticultural crops, and specialty crops comprises a very broad field of study. The studies include the influence on yield and quality of the size and plumpness of seed sown, dates of seeding, rates of seeding, etcetera. In horticultural crops culture has a profound effect on their ability to withstand storage.

Research in this field involves transportation and marketing, as well as yield of farm products and no hard and fast lines of demarkation can be drawn.

### **(d) Control of Pests and Diseases**

New insecticides, fungicides and weed killers are appearing on the market, together with equipment and suggested methods for their application. Studies of the practical value of these chemicals and the effectiveness of the equipment and methods of application have been undertaken and must be continued and probably expanded, to determine their usefulness in the control of pests and diseases in fruit, field and garden crops. Continued work with the older, established products and control measures must be maintained at present.

It would seem advisable to initiate more fundamental research on (1) plant insecticides (fruit, field, greenhouse and garden crops, shade and forest trees), (2) fumigants and insecticides, (3) fungicides and seed disinfectants and (4) herbicides. Further, it must be borne in mind that biological studies including taxonomy and anatomy, of various groups and species of insects, etcetera, of economic importance must not be disregarded.

Investigation of numerous plant diseases of the various types, such as water core in rutabagas, virus diseases of stone fruits, pepper, celery, cucumber, tomato and tobacco, fusarium disease of asparagus, bacterial and virus diseases of soybeans, black root disease of sugar beets, nematodes, etc., is being con-

ducted. Such investigations also embrace several allied fields of work, but in particular emphasize the need for continued and expanded research in the fields of plant physiology and phytopathology.

This field of control and eradication, where possible, of plant diseases, of weeds and harmful insects, etc., must continue to be co-ordinated with other fields of agricultural production.

#### **(e) Harvesting and Machinery**

Mechanization may be utilized to improve quality, quantity and efficiency of plant production by proper harvesting and crop handling methods and equipment. It is recommended that investigations be conducted to determine the suitability and practicability of introductory as well as standard types of equipment in the planting, handling and harvesting of crops. These investigations must be co-ordinated with studies as to yield and nutritive value of plants and crops as determined and recommended by plant breeders, animal husbandmen and nutritionists. The production and handling of hay to maintain high quality with a minimum loss of nutrients is worthy of more extensive study. Expansion of investigations in this field merit every assistance.

The improvement of pasture which involves investigation of soil fertility, management, plant breeding, nutritive value, etc., has been the subject of much study and resultant valuable contributions to agriculture. Nevertheless, the problems are by no means solved and continued investigations in this field are of paramount importance.

### **LIVESTOCK AND POULTRY PRODUCTION**

As human communities pass from predominantly pastoral to industrial areas, livestock and poultry production play an increasingly important part in the agricultural economy. Ontario, with its diversification of crops for animal feeding, a temperate climate, domestic market among industrial workers, and access to export markets, will continue to expand its livestock industry. Livestock and poultry, on a large proportion of the farms in this Province, are the main products through which crops are marketed, and the value of a sound soil fertility programme and the production of good crops will be wasted unless the quality of the livestock and poultry is high.

For a detailed presentation of this field see Appendices "N", "O", "P", "Q", "R", part of "S", "T" and part of "U" to the report of the July meeting at the Ontario Agricultural College.\*

#### **(a) Breeding**

Excellent progress has been made over a period of years in establishing specific types of swine, sheep, beef and dairy cattle suitable for the profitable production of meat, milk and wool. Such investigational work is valuable and necessary and must be continued, if such types are to be maintained and improved. However, it would appear that the time has come when research on such fundamentals as mode of inheritance of muscle tissue from the standpoint of carcass quality in bacon, mutton and beef production, isolation and establishment of families and investigation of the mode of inheritance in these strains

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\*Copies on file at—

- (1) Ontario Research Commission, 43 Queen's Park.
- (2) Legislative Library, Parliament Bldgs., Queen's Park.
- (3) Library, Ontario Agricultural College, Guelph.

of economy of feed utilization, etc., must be undertaken. It is strongly recommended that such basic genetic research be instigated and prosecuted to the fullest possible extent. Similar studies with chickens and turkeys are essential.

Research into various problems associated with artificial insemination, such as transportation, effect of dilutants, temperature, motility of semen and many other phases should be continued. This method of breeding is continuing to expand, and expansion always raises new problems which must be solved.

Investigation of the mode of inheritance of abnormalities such as cryptorchidism, herniae, etc., is worthy of special note. Such conditions resulted in an estimated loss of 65 to 75 thousand dollars in 1945 to the pig breeders of this Province.

## **(b) Nutrition**

The study of the nutrition of livestock and poultry is a central field in agricultural research. Not only is the practice of good animal nutrition the means to a financial end, but the achievement of good human nutrition through the production and proper utilization of agricultural food products, adequate in both quantity and quality, is a very important end in itself. Knowledge of animal nutrition has many implications and applications in the field of human nutrition. Hence, there is a vital interrelationship between medical and social sciences and those sciences which are conventionally considered agricultural.

Investigations into some phases of the many aspects of the fundamental nutritive requirement of the various classes and types of livestock and poultry, together with practical feeding problems and establishment of economic rations suitable for the production of quality products have been and are under study. Many factors such as intensified production, feed substitutions, have tended to accentuate the need of nutritional research both practical and fundamental. The field is continually expanding as new factors are isolated, as new investigational and bio-assay techniques become available and as new problems arise as a result of changes in soil fertility, new methods of production, etc. The scope and intensity of this work is not adequate to meet present needs.

There is no doubt that nutritional investigations must continue and it is recommended that expansion be facilitated, particularly in the livestock field.

## **(c) Disease Control**

Of all the factors which may contribute to losses in livestock and poultry, disease, either infectious or nutritional, would stand at the top of the list. It has been reported, as a result of a recent survey, that 23 per cent of the pigs born in a given period of time, died before weaning.

Research, including causes, treatment and control measures, into such diseases as mastitis in dairy cattle, abortion disease (bovine brucellosis), rhinitis in swine, horse cholera and encephalomyelitis, various diseases of fur-bearing animals, salmonella infections in poultry, disinfection of incubators, etc., are being steadily prosecuted. All such studies should be continued and expanded as facilities warrant.

Investigation of the control of such insects as warble flies, horn flies and other blood-sucking flies, lice, house and stable flies, etc., is being carried on. Such studies are not only important from the standpoint of economic livestock production but they also involve studies of the suitability, methods of application and chemistry of newer insecticides.



#### (d) Buildings and Machinery

There is an urgent need for investigational work and research in the designing, planning, remodelling of farm buildings on a proper functional basis. This applies not only to buildings in which the larger farm animals are housed but to poultry housing as well.

Similarly, there is a need for designing, re-designing, manufacturing and testing of farm equipment under the general heading of labour saving-devices. This is an important means of increasing farmers' labour efficiency.

#### (e) Apiculture

Many of the problems in breeding, feeding and disease in livestock and poultry production have counterparts in the field of apiculture. Studies of queen rearing and breeding, types of food for brood and queen rearing, diseases such as fowlbrood, nosema, etc., are being carried out. Such studies should be continued and must not be overlooked, as honey production is an integral part of Ontario agriculture, to say nothing of the role of bees in pollination.

### AGRICULTURAL ECONOMICS, FARM ORGANIZATION AND MARKETING

One of the limiting factors in the rapid improvement of agriculture in Ontario is the farmer himself. In contrast to industry, he is, to a large extent, his own labourer, foreman, production manager and sales manager. To expect any more than a limited number of men to combine all the qualifications necessary to understand the basic principles of soil management, crop production, animal production and farm management is to expect too much. Research in farm management and the marketing of agricultural products is essential, both from the point of view of the individual farmer and the legislator and administrator who is responsible for the development and guidance of agricultural policies.

Better farm management would mean more efficient or lower cost production which would permit more satisfactory price competition of all farm products on domestic or foreign markets. The marketing field is a major part of our general agricultural economy. A study of the methods of co-operative and non-co-operative agencies operating in the various fields would yield information on the best marketing methods and, at the same time, give information on the requirements for maintenance and expansion of domestic and export markets.

In addition, continued study of the production costs of agricultural products such as meat, milk, eggs, cereals, fruits, vegetables, etc., must be maintained. Such studies necessarily involve correlation with efficiency of production.

Marketing involves such factors as packaging, improvement of quality, processing, storage and refrigeration, development of manufacturing methods for new products and so on. The nutritional value of the product must not be disregarded. It hardly need be pointed out that marketing involves every branch of production and, again, no line can be drawn between marketing and production.

It would seem that this phase of agricultural research could be enlarged with resultant benefit. Almost every agricultural product involves its own specific marketing problems.

The possible utilization of agricultural products and by-products in new industrial fields warrants further investigation.

For further details see Appendices "V" and "W" and parts of Appendices "E" and "U", of the July meeting at the Ontario Agricultural College.\*

## CONTINUITY OF RESEARCH PROGRAMMES

It must be obvious to anyone who has studied the reports of the Sub-Committees and of the July meeting at the Ontario Agricultural College that many of the problems are basic and that a sound programme for Ontario agriculture cannot be maintained unless these problems are solved. Many of these are long-time problems. Continuity of support is essential to their solution.

All Sub-Committees are agreed that such continuity involves both finances and personnel. It is recommended that a Research Fund, to be administered through the usual Government channels, should be established in continuity, adequate to permit various necessary projects to be pursued as personnel and facilities are available.

## EXTENSION AND PUBLICITY

It is of no use for the research worker to solve an agricultural problem and lock up the answer in his files, or, at most, to record it in a scientific journal to be placed on the shelves of libraries. The solution of a problem must be carried through to farm practice and that particular part of farm practice must fit into a sound programme of farm management. It will be useless to expand agricultural research unless the machinery is functioning which will teach the farmer how to apply the solution worked out by the scientist.

## 4. ORGANIZATION AND MAINTENANCE OF SERVICES

### APPRECIATION OF THE PROBLEM

(a) No industry is as well organized as agriculture from the point of view of research facilities, extension services, and legislative machinery to cope with the basic problems of the industry. The temporary limiting factors in the carrying out of a more extensive programme are additional personnel, equipment, and space. Adequate funds to correct this situation will be secured through the regular channels.

(b) Problems tend to come to the established and recognized agricultural institutions due to their direct contacts with the farming public, their close association with the Agricultural Representative Service, and with graduates of the Agricultural College, in practical farming and industries allied to agriculture.

(c) It is the duty of all branches of the agricultural services to anticipate problems. Further, two specific non-research units, namely: the Plant Protection Division and the Health of Animals Division of the Dominion Department of Agriculture, are charged with the responsibility of preventing the entry of plant and animal pests and diseases into Canada.

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\*Copies on file at—

(1) Ontario Research Commission, 43 Queen's Park.  
(2) Legislative Library, Parliament Bldgs., Queen's Park.  
(3) Library, Ontario Agricultural College, Guelph.

(d) The teaching and extension in agriculture being major activities of agricultural institutions, staff, equipment, library facilities, etc., are basically suitable for the conduct of agricultural research. Moreover, a research programme is vital to teaching and extension and especially for post-graduate studies to maintain the supply of well-trained personnel.

(e) Your Committee is of the opinion that the field of agricultural research can be adequately served by the Ontario Agricultural College, Ontario Veterinary College, Provincial Experimental Stations and the Dominion Department of Agriculture, and to a certain extent by research units in the Ontario Research Foundation and the National Research Council. It is felt that other university Faculties of Science in the Province should not be engaged in agricultural research per se, but should confine their activities to co-operation with the above agencies on specific phases of agricultural research problems, and to assist in the training of post-graduate students who require the special courses and facilities available for the particular training required. The Committee feels that such students' courses and thesis projects should be discussed with recognized agricultural research authorities in the field in which the student expects to work.

(f) The Committee feels that it is impossible to draw hard and fast lines allocating specific fields of research to various institutions. It is not possible to allocate fundamental research, so-called, to one institution and applied research or experimentation and investigation to another. Actually, all types of problems are referred by the public to all institutions concerned, and in practice the research workers divide and allocate the work according to personnel and facilities available.

## CO-ORDINATION OF EFFORT

In spite of the numerous units of federal and provincial agencies engaged in agricultural work, the Committee finds a large measure of co-ordination and little or no unnecessary duplication in research.

In two limited fields, namely Phytopathology and some phases of Bacteriology, the Committee agrees that closer co-ordination would be advantageous. The workers in these two fields are aware of the situation and the necessary corrective steps are being taken.

Appendices "H" and "Y" to the report of the July meeting at the Ontario Agricultural College\* give a resume of the research services of the Dominion Department of Agriculture. Appendix "Y", subsequently prepared by Science Service, Dominion Department of Agriculture, gives a concise picture of the research in the various divisions of this Service. A book entitled "The Dominion Experimental Farms" gives a complete story of this Branch.

The following are some examples of co-operation and co-ordination between federal and provincial services:

### (a) National Committees

National Committee on Agricultural Engineering.

National Agricultural Outlook Committee.

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\*Copies on file at—

- (1) Ontario Research Commission, 43 Queen's Park.
- (2) Legislative Library, Parliament Bldgs., Queen's Park.
- (3) Library, Ontario Agricultural College, Guelph.



National Barley and Linseed Flax Committee.  
National Beef Cattle Committee  
National Feed Committee.  
National Sheep Committee.  
National Committee on Soil Conservation.  
National Soil Survey Committee.  
National Weed Committee.  
National Seed Grain Committee (being abolished).  
National Dairy Cattle Committee (being organized).  
National Swine Committee (being organized).

**(b) Federal-Ontario Committees**

Corn Committee  
Winter Wheat Committee.  
Soybean Committee.  
Pasture Committee.  
Soil Survey Committee.  
Potato Investigation Committee.  
Ontario Fruit and Vegetable Spray Service.  
Tobacco Fertilizer Committee.  
Sugar Beet Nematode Committee.  
Ontario Feed Board.  
Ontario Fertilizer Board.  
Ontario Crop Improvement Association.  
Committee of Ontario Bee-Keepers Association.

**(c) Interdepartmental Committees and Conferences**

Ontario Dairy Research Council.  
Pullorum Conference.  
Feedstuffs Act—Sub-Committees on Vitamins, Minerals, etc.  
Ontario Poultry Industries Committee.  
Joint Studies and Control (Corn Borer, Cutworm, Nematode, Japanese Beetle, Dutch Elm Disease, etc.).  
Co-operative Crop Testing Committee (apportioning of test work on area basis).

## TYPICAL CURRENT CO-OPERATIVE PROJECTS\*

### (a) Dominion Projects

Breeding of disease resistant varieties of farm crops, including the introduction into Ontario of plant breeding material from foreign countries.

(Experimental Farm—Forage Crops, Cereals, Horticulture; Science Service—Botany and Plant Pathology).

Pregnancy testing of mares.

(Experimental Farm—Animal Husbandry; Science Service—Chemistry).

Tattooing registration numbers on live stock.

(Experimental Farm—Animal Husbandry; Science Service—Chemistry).

Pullorum control in poultry.

(Experimental Farm—Poultry; Science Service—Animal Pathology).

Mastitis of dairy cattle.

(Experimental Farm—Animal Husbandry; Science Service—Animal Pathology).

Bacterial ring rot of potatoes.

(Science Service—Plant Pathology and Plant Protection).

Fertilizer experiments on a wide variety of crops.

(Experimental Farm Divisions; Science Service—Chemistry).

### (b) Dominion-Ontario Projects

Potato production—tillage, fertilizers, etc.

(Experimental Farm; Ontario Agricultural College).

Potato spraying—disease and insects.

(Science Service; Provincial Entomologist.)

Soil Survey.

(Experimental Farm; Soils Department, Ontario Agricultural College.)

Sugar Beet Nematode

(Science Service; Provincial Entomologist.)

Spray calendars.

(Science Service; Ontario Agricultural College; Fruit Branch.)

Tobacco Production—varieties, fertilizers, disease and insects.

(Experimental Farm; Science Service; Ontario Agricultural College.)

Sugar Beet Diseases.

(Experimental Farm; Science Service; Ontario Agricultural College.)

Alsike Clover Production.

(Experimental Farm; Science Service; Ontario Agricultural College.)

Pullorum disease of Poultry

(Science Service; Ontario Agricultural College; Ontario Veterinary College.)

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\*For details of these and numerous other projects already reported, see report of Ontario Research Commission Meeting, July 10th, 1946, at the Ontario Agricultural College, Guelph. \*\*

\*\*Copies on file at—

(1) Ontario Research Commission, 43 Queen's Park.

(2) Legislative Library, Parliament Buildings, Queen's Park.

(3) Library, Ontario Agricultural College, Guelph.

Vitamin D Studies.

(Science Service; Experimental Farm; Ontario Agricultural College.)

(c) **Provincial Projects**

Livestock diseases—mastitis, calfhooed vaccination in Bang's disease, rhinitis in swine.

(Ontario Veterinary College; Animal Husbandry, Ontario Agricultural College.)

Forage crops—varietal tests, nutrient content.

(Ontario Agricultural College, Field Husbandry, Animal Husbandry, Animal Nutrition; Ontario Pasture Committee.)

Grain and seed—malting barley, soybeans, winter wheat.

(Ontario Agricultural College, Field Husbandry; Canada Malting Co.; Brewers' Warehousing Co.; Toronto Elevators; Maple Leaf Milling Co.)

Weed control—chemical killers.

(Ontario Agricultural College, Botany, Field Husbandry, Horticulture, Ontario Crops, Weeds and Seeds Branch; Dominion Rubber Co.)

Insecticides and fungicides.

(Ontario Agricultural College, Entomology, Botany, Animal Husbandry.)

Dairy Products—Vitamin A activity of butter, flavour of butter, retention of nutrients in cheese.

(Ontario Agricultural College, Dairy, Chemistry, Bacteriology, Animal Nutrition; Hospital for Sick Children, Toronto; Dairy Branch, Ontario Department of Agriculture.)

Non-specific seriological pullorum reactions.

(Bacteriology and Poultry Departments, Ontario Agricultural College.)

Turnip Breeding and Testing.

(Botany, Bacteriology, Entomology, Field Husbandry Departments, Ontario Agricultural College.)

Poultry Nutrition—Diets for chicks, poults and breeders, shell quality, vitamin content of eggs.

(Ontario Agricultural College, Animal Nutrition, Poultry; Hospital for Sick Children, Toronto.)

Canning crops—soil, fertilizer and varietal tests, field studies.

(Ontario Agricultural College, Chemistry, Soils, Field Husbandry; Campbell Soup Co.)

Atherosclerosis in chickens—Cholesterol feeding.

(Ontario Agricultural College, Animal Nutrition and Poultry; University of Western Ontario Medical School.)

**RECOMMENDED PROJECTS—AGRICULTURAL RESEARCH—1947-48**

Title	Agency	Capital	Operating	Total
Agricultural Products . . . . .	Ontario Research Foundation	\$2,000.00	\$18,000.00	\$20,000.00



## 5. CONCLUSION

The members of the Advisory Committee on Agricultural Research wish to express their appreciation of the interest shown in the problem of agricultural research by the Ontario Research Commission and for the opportunity to present this statement.

It is hoped that the Commission will be sufficiently impressed with the character of the programme presented to give full support in every way to its furtherance.

### COMMITTEE ON MINES, MINERALS AND METALLURGY RESEARCH

#### Meetings—

- Informal.....Sept. 12th, 1946—Committee Room No. 2, Parliament Bldgs.  
Formal.....Nov. 15th, 1946—Committee Room No. 2, Parliament Bldgs.

#### Committee—

Professor H. S. Armstrong.....	McMaster University
Professor E. L. Bruce.....	Queen's University
Professor O. A. Carson.....	Queen's University
Dr. O. W. Ellis.....	Ontario Research Foundation
Mr. Chas. Evans.....	Union Gas Company
Dr. G. Farnham.....	International Nickel Co.
Dr. D. L. H. Forbes.....	Teck Hughes Gold Mines
Professor J. E. Hawley.....	Queen's University
Mr. N. Parkinson.....	Ontario Mining Association
Professor L. M. Pidgeon.....	University of Toronto
Professor G. H. Reavely.....	University of Western Ontario
Dr. H. C. Rickaby.....	Lands and Forests, Ontario
Mr. R. H. Rimmer.....	Aluminum Co. of Canada Laboratories
Mr. W. Samuel.....	Steep Rock Iron Mines
Mr. Geo. Thomson.....	General Engineering Co. of Canada
Mr. W. B. Timm.....	Dept. Mines and Resources, Ottawa
Dr. C. Whittemore.....	Deloro Smelting & Refining Co.
Mr. G. E. Willey.....	Algoma Steel Co.
Professor C. G. Williams.....	University of Toronto
Professor J. T. Wilson.....	University of Toronto
Mr. R. B. Young.....	Ontario Hydro-Electric
Mr. T. Hardy.....	Climax Molybdenum Co.

# CONTRIBUTION TO DISCUSSION ON MINES, MINERALS AND METALLURGICAL RESEARCH IN ONTARIO

## O. W. Ellis, Ontario Research Foundation

Just before the war, in 1938 to be exact, the Department of Engineering and Metallurgy, with a staff, under the speaker's direction, of four graduates and six technicians, was carrying out independent research work along the following lines:

1. Resistance of metals to abrasion—O. W. Ellis and P. E. Cavanagh.
2. Powder Metallurgy—W. R. Jackson.
3. Forgeability of metals—O. W. Ellis and technician.
4. Magnetic Inspection of Metals—F. E. Coombs ( $\frac{1}{2}$  year) and P. E. Cavanagh.
5. Applied elasticity—J. N. Goodier ( $\frac{1}{2}$  year).
6. Effects of manganese and silicon on white cast iron—C. Tasker and technician.

At the same time these graduates and the technicians were available to assist the Director of the Department in the solution of problems of industrial development, that is, problems which involve the application of present knowledge to their solution.

In response to a widespread demand, work on the resistance of metals to abrasion was started at the Foundation shortly after it was created and has continued ever since. There can be no question as to the importance of this work, because any means whereby abrasion of metals in service can be inhibited is of vital importance to the consumer. Conservation is as vital here as it is elsewhere. The present interest of manufacturers in this subject is evidenced by the fact that during the course of the last two or three weeks enquiries have been received from no less than three different sources, one even from Belgium regarding the work of the Foundation in this field. Another of these enquiries raises the possibility of establishing a Fellowship at the Foundation to investigate the wear of grinding balls. The last refers to the problem of abrasion in agricultural machinery. The Foundation is one of the few places in the world where research on this important subject has been consistently pursued. It is to be hoped that work along these lines may be continued.

The Foundation is equipped with one of the best powder metallurgy laboratories on the North American continent. Prior to 1941 a number of short term investigations were carried out in this field on behalf of manufacturers in the Province. Concurrently independent work was done on a number of ferrous alloys. At the present time the National Research Council is sponsoring a Fellowship which involves the application of powder metallurgy to its solution. We would like to see independent work in this field revived.

Work on the forgeability of metals was started by the writer while he was on the staff of the University of Toronto and has been continued ever since. The results of this work have proven of value in certain fields of engineering. An equation developed by us and relating the energy required to forge metals and the dimensions of the parts being forged is being employed by a number

## Director

	AND				Development		Service	
	Independent							
Effects of Manganese and Silicon on White Cast Iron (1)	Resistance of Metals to Abrasion (1)	Magnetic Inspection of Metals ( $\frac{1}{2}$ )	Powder Metallurgy (1)	Applied Elasticity ( $\frac{1}{2}$ )	Machine Shop (4)	Heat Treatment (1)	Physical Metallurgy (1)	

## 1946

## Director

	AND				Development		Service	
	Sponsored Research	*						
Nat. Res. Coun. (2)† Powder Metallurgy	Dumont (1)† Magnetic Inspection of Metals	Dofasco (1)† Steel Production Problems			Machine Shop (3)	Heat Treatment (1)†	Physical Metallurgy (1)	

\*No connection between these two divisions.

Number of men engaged in each division shown in brackets. Where  $\frac{1}{2}$  appears in brackets 6 months period only worked.

†Self-supporting.



of engineers working in this field. There are still points of interest which need to be investigated. A technician is needed to assist in this work.

Our work on the magnetic inspection of metals, which was a by-product of our work on the resistance of metals to abrasion, resulted in incalculable savings to industry during the War. Not only so, but this work was the indirect cause of the development of two new types of electrical instruments for the non-destructive testing of metals, namely the Cyclograph and Cable Tester. The Dumont Company of Passaic, N.J., was directly responsible for this development. They have established a Fellowship at the Foundation, the incumbent of which is the young man, Mr. P. E. Cavanagh, who, in 1938, co-operated with the speaker in the investigation of the resistance of metals to abrasion. We are anxious to pursue our investigations in this field, and, in particular, to correlate the electrical and magnetic properties of metals when under stress.

The work of Dr. Goodier in the field of applied elasticity is well known to most of the engineers in this group. Most of them will agree with me that it was a great pity that we lost to the United States a man having the outstanding ability of Dr. Goodier.

Our work on the effects of manganese and silicon on white cast iron was yet another outcome of our work on the resistance of metals to abrasion. Certain of the alloys investigated by us were found to have physical and mechanical properties of considerable interest. Some of these alloys were used on a small scale in a rather special industrial application. A further reason for pushing forward with this work is that our investigations have shown that published information regarding these alloys is far from correct and should be amended in line with further investigation. A technician is needed for this purpose.

At the moment work on these subjects is practically at a standstill. Whereas in 1938, four graduates were employed in independent research and were available to assist the speaker in development work, at the present time only one recent graduate is at hand. It is true that three Fellowships, sponsored by the National Research Council, Dumont, and Dominion Foundries and Steel Company Limited respectively, are operating at the present time, but independent investigation on the resistance of metals to abrasion, the magnetic inspection of metals, powder metallurgy and the effects of manganese and silicon on white cast iron cannot be proceeded with unless further assistance is given the Department. A comparison of the situations in 1938 and 1946 can be gathered by reference to the table on page 117,

# CONTRIBUTION TO DISCUSSION ON MINES, MINERALS AND METALLURGY

R. J. Traill, Bureau of Mines, Ottawa

Mr. Parsons has presented a brief general outline of the facilities of the Bureau of Mines Laboratories at Ottawa and its general policy with respect to service to the needs of Canadian Industry.

I am asked to present a statement of the research being done in the Mineral Dressing and Metallurgical Division and to include recommendations for extension of the work.

As outlined by Mr. Parsons this Division comprises three main sections, namely:

1. Mineral Dressing and Extractive Metallurgy.
2. Physical Metallurgy Research.
3. Ceramics and Non-Metallics.

While much of the work coming to the Mineral Dressing Section is of a routine investigation character, there is quite a proportion of problems that entail special study or research investigation. Refractory gold ores and complex base metal ores may be cited as examples wherein methods other than those usually employed have to be investigated and developed.

Recently, we have been investigating the "sintering" of certain Ontario iron ores with the purpose of developing a technique to produce a better sinter.

Certain complex fluorspar deposits have also been receiving attention, the problem being to eliminate co-occurring minerals such as calcite and barite and produce a readily marketable product.

A special investigation in hand at present concerns the radioactive minerals, rapid methods of radiometry being of special importance and attention.

There are, however, quite a number of matters relating to Mineral Dressing that could profitably be the subject of research. such as Roasting sulphide-arsenide gold bearing concentrates, a complete study of the behaviour of metallic minerals in cyanidation, a study of the process of flotation and reagents, the occurrence of gold, chlorine metallurgy, utilization of pyrite for sulphur and iron, etc.

There is much fundamental data yet to be obtained concerning the above problems and this Division has not had sufficient staff in the past to carry out such research and at the same time meet the current demands of industry.

There are also problems in metal refining and in the production of pure metals.

Regarding the Physical Metallurgy Laboratories the activities and facilities of this section are summarized in the attached memoranda. The facilities here outlined are being added to continually with the latest available equipment. It will be seen that these Laboratories can serve industry in many ways. In addition, an effort is being made to carry on a number of research projects.

Some idea of the work being performed may be obtained from the data given in the following pages,

In the Ferrous Section, the Welding Laboratory is investigating welding methods on all types of metals and alloys and co-operating with various organizations in development of new techniques.

In the Ferrous Foundry, research projects involving foundry sand properties are in hand in co-operation with the Steel Castings Institute of Canada. A plan of co-operative research is being arranged with the British Cast Iron Research

Association.

The Sand Testing Laboratory is testing sands from various parts of Canada in an effort to find Canadian sands suitable to foundry uses.

In the Precision Casting Laboratory the various techniques have been evaluated for various alloys, especially high melting point alloys.

The Ceramic Laboratories, formerly under the Industrial Minerals Division have recently been attached to the Mineral Dressing and Metallurgy Division.

In addition to the usual industrial service activities these laboratories are conducting special investigations in special refractories, porcelain from Kaolin, whiteware body manufacture, crucible linings, and are starting a study of high temperature phase equilibria in the field of ceramics and refractories.

From this general summary it will be seen that the Mineral Dressing and Metallurgy Laboratories are well equipped with the necessary facilities for research of a character required in the metallurgical industries.



# PHYSICAL METALLURGY RESEARCH LABORATORIES

## Brief Outline of Activities and Facilities

The activities and services of the Physical Metallurgy Research Laboratories of the Bureau of Mines can be summarized as follows:

1. **Fundamental and Applied Research** in the field of physical metallurgy including studies on physical, mechanical and chemical properties of metals and alloys, their fabrication techniques (melting, alloying, casting, rolling, extrusion, forging, drawing, heat treatment, joining and surface protection), testing methods and proper applications.
2. **Development of Fabricating Methods** of metallic products for special applications or for new alloys.
3. **Testing of Metals and Alloys**, and their products, submitted to the P.M.R.L. for examination of properties, fabricating characteristics and serviceability, or to establish causes of failure in production or service.
4. **Advisory and Information Service** for other Government agencies, Branches of the Armed Services, Industrial Organizations and Individuals on properties of metals and alloys, fabrication and testing methods, and proper applications.
6. **Collecting of Scientific and Technical Data** on metals and alloys, their properties, fabrication and testing methods, and serviceability compiled from publications and information accumulated from experimental work and co-operation with other research organizations and industry.

To attain the above aims the organization and the facilities of the P.M.R.L. are divided into five main Sections comprising the following laboratories, experimental shops and services:

### (1) Ferrous Metals Section:

Ferrous Experimental Foundry (Sand Casting).  
Ferrous Metallography and "Trouble-Shooting".  
Ferrous Heat Treatment.  
Welding Laboratory.  
Sand Testing Laboratory.  
Precision ("Lost-Wax") Casting.  
Photographic Service.

### (2) Non-Ferrous Metals Section:

Non-Ferrous Experimental Foundry (Sand, Permanent Mould, Pressure Die, Centrifugal and Billet Casting).  
Metal Forming Laboratory (Rolling, Extrusion, Forging, Drawing, etc.).  
Non-Ferrous Heat Treatment.  
Non-Ferrous Metallography and Radiography.  
Non-Ferrous "Trouble-Shooting".

### **(3) Mechanical Testing Section:**

- Routine Testing.
- Fatigue Testing.
- High Temperature Alloys Laboratory (Creep).
- Low Temperature Testing.
- Stress Analysis.
- Shot Peening.

### **(4) Physical Section:**

- Testing of Physical Properties (thermal, electrical, etc.).
- X-Ray Diffraction.
- Analysis of Gases in Metals.
- Powder Metallurgy.
- Glass Blowing Shop.
- Statistics.

### **(5) Chemical Section:**

- Corrosion Laboratory.
- Surface Protection of Metals.
- Pickling Shop (for the Metal Forming Laboratory).
- Extractive Metallurgy.

The Analytical and Spectrographic Laboratories are shared with the Mineral Dressing Laboratories. Preparation of test specimens and construction of equipment is carried out by the various workshops of the Maintenance Section of the Bureau of Mines.

Brief descriptions of the activities and equipment of the above listed Sections, as well as some photographs of building and equipment can be furnished if desired.

**PHYSICAL METALLURGY RESEARCH LABORATORIES  
BUREAU OF MINES**

**DIVISION OF METALLIC MINERALS**

**MECHANICAL SECTION**

The general functions of the Mechanical Section of the Physical Metallurgy Research Laboratories; the present programme of Research Projects and the equipment are outlined very briefly in the following notes:

The main activities of the Mechanical-Metallurgical Section may be divided as follows:

- (a) Solution of vital problems for industrial organizations, involving fracture investigations, production difficulties, new developments, etc., and the provision of answers to technical questions.
- (b) The carrying out of large research projects put forward by Canadian industry and the Industrial Research Organizations or by Government departments.
- (c) Research projects initiated by the Physical Metallurgy Research Laboratories Research Committee and influenced by the current and probable future needs of the Canadian industry and Government departments.
- (d) Research projects performed in collaboration with the Research Organizations, Institutes, Universities, and Industrial Organizations in Canada, Britain and the U.S.A. and covering the most vital needs of Canadian science and industry.

The major investigations and researches at present in progress in the Mechanical Section of the Physical Metallurgy Research Laboratories are given below:

- 1. **Research on Optimum Thread Form for Proposed Anglo-American Canadian Screw Thread.**
- 2. **Research on the Axiality of Loading Using Plain and Spherical Seat Adaptors under Static and Dynamic Direct Loading.**
- 2. **Research on the Progress of Plastic Deformation of Samples Undergoing the Fatigue Tests.**
- 4. **Magnetic Analysis of the Progress of Plastic Deformation.**
- 5. **High Frequency Magnetic and Eddy Current Losses and Their Relation to Internal Stresses and Plastic Deformation in Fatigue.**
- 6. **Comparative Examination of the Physical Properties of SAE 4340 Steel Heat Treated in Three Different Ways.**
- 7. **Fatigue Properties of Various Steels.**
- 8. **Determination of the Effect of Shot Peening on the Fatigue Characteristics of SAE 1045, 3140, 4140 and NE 8640 Steels.**
- 9. **High Temperature Fatigue Research** (under reversed bending conditions).
- 10. **High Temperature Fatigue Research** (under direct stress loading).
- 11. **High Temperature Creep Investigations.**
- 12. **Analysis of Residual Stresses.**



## **EQUIPMENT—MECHANICAL SECTION**

The Mechanical Section of the Physical Metallurgy Research Laboratories is equipped with the following machines and instruments:

### **1. General Mechanical Testing Laboratory:**

- (a) Tensile Compression and Shear Testing Machines.
- (b) Hardness Testing Machines.
- (c) Impact Testing Machines.
- (d) Ductility Testing Machines.

### **2. Stress Analysis Laboratory:**

- (a) Brittle Lacquers.
- (b) Electrical Strain Gauges.
- (c) Extensometers.
- (d) X-Ray Apparatus for Stress Determinations.
- (e) Magnetic Analysis Apparatus.

### **3. Fatigue Testing Laboratory:**

- (a) Rotating Beam Type Machines.
- (b) Push-Pull (Direct Stress Loading Machines).
- (c) High-Temperature Fatigue Machines.
- (d) Corrosion Fatigue Testing Machines.
- (e) Aircraft Cable Fatigue Testing Machines.
- (f) Shot Blasting Equipment.

### **4. High Temperature Creep Laboratory:**

- (a) High-Temperature Creep Testing Machines.
- (b) High-Temperature Tensile Testing Machines.

## **CHEMICAL METALLURGY RESEARCH SECTION**

**Bureau of Mines, Ottawa, Canada**

### **PURPOSE**

The Chemical Metallurgy Research Section is responsible for investigating chemical processes which occur in or are important to the field of metallurgy. These processes are:

- 1. The corrosion of metals and its prevention.
- 2. Methods of producing corrosion-resistant alloys.
- 3. Methods of producing corrosion-resistant, abrasion-resistant and decorative coatings for metals.
- 4. Methods of producing pure metal compounds from ore concentrates of the metals (including the rarer metals).
- 5. Methods of producing metals (including the rarer metals) from their compounds.
- 6. Electrolytic methods of producing metal powders.

## EQUIPMENT

The following equipment is in use in this laboratory at the present time:

Sources of alternating and direct current for various types of electrolytic work.

Sandblasting equipment.

Paint spray equipment.

2 accelerated indoor atmospheric corrosion cabinets.

Accelerated outdoor atmospheric corrosion cabinet together with freezing cabinet.

2 Accelerated marine atmospheric corrosion cabinets.

Rapid intermittent immersion corrosion equipment.

Slow intermittent immersion equipment.

Total immersion corrosion equipment.

Stress corrosion testing equipment.

Steam cabinet for accelerated corrosion testing.

Water displacement test equipment.

Taber Abrasor for determining wear resistance and shear hardness of coatings.

Aminco-Brenner Magne-Gage for measuring coating thickness.

Solvent vapor degreaser.

Miscellaneous instruments for measuring pH, conductivity, voltage, current, etc.

The following equipment will be installed in the near future:

40 kva high frequency converter and miscellaneous assortment of induction furnaces;

furnaces for heating under vacuum or reduced pressure;

electrolytic hydrogen generator and equipment for purifying and drying the hydrogen.

We also have access to microscopes and other metallographic equipment and to the analytical, spectrographic, mechanical testing, machine shop and other facilities of the Bureau of Mines.

## NON-FERROUS METALS SECTION, P.M.R.L.

### Brief Outline of Activities and Equipment

The activities of the Non-Ferrous Section, P.M.R.L. are divided as follows:

#### (A) Non-Ferrous Experimental Foundry

1. Melting and Refining.
2. Sand Casting.
3. Permanent Mould Casting.
4. Centrifugal Casting.
5. Pressure Die Casting.
6. Slab and Billet Casting.

7. Magnesium Alloying.
  8. Development of Aluminum -Magnesium Alloys.
  9. Properties of Magnesium Casting Alloys.
- (B) **Heat Treatment of Non-Ferrous Metals**
1. Heat Treatment of Magnesium Casting Alloys.
  2. Heat Treatment of Aluminum-Magnesium Alloys.
- (C) **Plastic Deformation of Non-Ferrous Metals.**
- (D) **Metallography and Radiography.**

The main facilities of the Non-Ferrous Section are listed below. Additional equipment, e.g., recording and controlling apparatus, auxiliary tools, crucibles, patterns, moulds, etc., are omitted.

## A. NON-FERROUS EXPERIMENTAL FOUNDRY

### 1. Melting Furnaces:

- (a) Gas fired Holding Furnace for magnesium, aluminum and brass permanent mould and pressure die casting.
- (b) Gas fired magnesium melting furnace, 90 lb. capacity.
- (c) Two gas fired melting furnaces for aluminum and magnesium alloys, capacity 50 lb. Al.
- (d) Two coke fired Pit furnaces for bronzes and brass, capacities for 50 lb. and 150 lb.
- (e) Small gas fired furnace for experimental melting, capacity 10 lb. Al.
- (f) Ajax High-Frequency Vacuum furnace, capacity 50 lb. brass; this furnace can be used for melting and pouring under protective atmospheres.
- (g) Two Ajax High Frequency furnaces, capacity 500 lb. and 50 lb. brass.

All melting furnaces have accurate temperature control and recording.

2. **Pressure Die Casting Machine** for aluminum, magnesium and brass. Pressures on the metal up to 3k,000 p.s.i. and additional goose-neck attachment for zinc alloys.
3. **Vertical Centrifugal Casting Machine** for moulds up to 30 ft. in diameter and continuously variable speed control 0-1700 R.P.M.
4. Complete **equipment for permanent mould casting** of aluminum and magnesium alloys.
5. Various permanent moulds for **casting of rolling slabs and extrusion billets** from aluminium, magnesium, copper and zinc alloys.
6. **Semi-continuous (D.C.) Casting Machine** for rolling slabs and extrusion billets up to 8' length will soon be installed.
7. **Sand Preparation Equipment** including a Simpson Sand Mixer 3' diam. and 1 1/2 cu. ft. capacity, vibrating Screen, Royer jolt-squeeze moulding machine, small Royer sand conditioner, core moulding bench, etc.



8. **Complete Sand Testing equipment** including all routine sand testing A.F.A. apparatus, and special equipment for sand testing at elevated temperatures.
9. **Core Oven**, electrically heated, approximately 16 cu. ft. capacity.
10. **Auxiliary equipment**, e.g., a 3 ton crane, ladles, flasks, etc.

## B. NON-FERROUS HEAT TREATMENT

1. **Small Homo-Furnace** (Leeds and Northrup) 12.5" diameter and 15" deep, with forced air circulation and Micromax controlling and recording instruments. This furnace is used for solution heat treatment of low zinc containing magnesium alloys and for ageing of all magnesium alloys.
2. **Small Homo-Nitriding Furnace** (Leeds and Northrup), 14" diameter and 16" deep, with Micromax controlling and recording instruments. This furnace is used for heat treatment of magnesium alloys under protective atmospheres (mostly CO<sub>2</sub>).
3. **Two Walker Vertical Tempering Furnaces** (with forced air circulation) with retorts 13" diameter and 14" deep, capable of operating up to 700°C (1300°F). Used for preheating of melting charges and heat treatment of light metals.
4. **Constant Temperature Oven** with forced draft, temperature range up to 260°C (500°F), inside dimensions 37" x 19" x 25". Used for ageing and stress relief treatments.

Other heat treating facilities used for Non-Ferrous metals comprise various heat treating furnaces for steel, small laboratory furnaces and two large furnaces in the Metal Forming Laboratory.

## C. METAL FORMING LABORATORY

(At present being erected.)

1. A 18" x 18" two or four high reversible **Rolling Mill**, powered by a 300 H.P. Ward Leonard controlled drive, intended for hot and cold rolling of sheet and strips, as well as bars. The mill is equipped with winders and a hot upcoiler for strip, and with indicating and recording instrument of roll pressure.

The mill was built by Dominion Engineering Limited, Montreal, Canada, from designs prepared by United Engineering and Machine Company of Pittsburgh.

2. A **750-ton Horizontal Direct Hydraulic Extrusion Press**, with billet containers from 3½" to 7" in diameter and 16" length. The press is equipped with a 150 ton piercer which may be added to the main ram to provide 900 ton capacity.

This machine was built by Loewy Engineering Company of Canada, Ltd., Montreal.

3. A **25-ton** variable speed chain **Drawing Bench** for 15 ft. long rods and tubes.

This machine was built by Aetna Standard Engineering Company of Youngstown, Ohio, U.S.A.

4. **A 500-lb. Combination Drawbench and Wire Block.**
5. **A 1500-lb. Double Frame Forging Hammer**, arranged for operation by air, having 30" stroke and 9" x 15" die face.

This machine was built by John Bertram and Son, Ltd., Dundas, Ontario.

6. **A 1200 ton double acting Universal Hydraulic Press** is under consideration for press-forging, sheet forming, powder metallurgy, etc.
7. Two 3' x 3' x 16' car bottom **furnaces** for heating billets and slabs, annealing and solution heat treatment of wrought products; One is an electric furnace with forced air circulation for temperatures up to 650°C (1200°F), and the other is oil fired for temperatures up to 1300°C (2400°F). Both furnaces are provided with very accurate temperature controls and can be used for heat treatment under protective atmospheres.

These furnaces were built by Peacock Brothers, Ltd., Montreal, to designs of the Electric Resistance Furnace Company, Ltd., Netherby, Queen's Rd., Haybridge, Surrey, England.

8. **Auxiliary equipment** comprises sheet shears, bandsaw, slab and billet scalping equipment, a 5 ton crane, etc.
9. **Pickling shop** with six tanks to handle the products of the Metal Forming Laboratory. The tanks are provided for a variety of solutions.

## D. METALLOGRAPHY AND RADIOGRAPHY

1. Zeiss Metallographic Microscope (older type) with complete set of accessories.
2. Bausch and Lomb Metallographic Microscope, Research Model, with complete optical accessories for both bright and dark field illumination and polarized light.
3. Vickers Projection Microscope with complete accessories for bright and dark field illumination and polarized light, also microscopic attachment and accessories for using transmitted light.
4. **Three Table Microscopes** for routine examinations.
5. **Tukon Microhardness Tester**, complete with microscope and mechanical stage (Knoop Hardness).
6. Eberbach Microhardness Attachment (Vickers type indentations).
7. Spencer Bierbaum Microcharacter (microhardness testing of bearing alloys).
8. Complete **Sample Preparation Equipment** including cut-off wheels, mounting press, grinding, polishing and etching facilities.
9. **150 Kvp X-Ray Unit** (Philips Electronic Searchray Model 150) for radiographic examination of light metals (up to 4" thickness) and steel (up to 1/2" thickness).

# ACTIVITIES OF THE FUELS DIVISION BUREAU OF MINES, OTTAWA

## IN RELATION TO THE FUEL RESOURCES OF THE PROVINCE OF ONTARIO

The fuel resources of Ontario, with which this Brief deals, are Onakawana lignite, peat fuel and moss, and natural gas. The Fuels Division activities reviewed concern tests on investigations conducted during the period 1928 to 1942 and those that merit consideration in the near future. A selected reference list including both published and unpublished reports originating in the Bureau of Mines, Ottawa, the Ontario Research Foundation, the U.S. Bureau of Mines, and elsewhere is given on page 134.

### ONAKAWANA LIGNITE

Starting with analyses and small scale burning, carbonization and briquetting tests on outcrop samples submitted in 1928 and 1929, a series of tests were conducted at the Fuel Research Laboratories at Ottawa on carlot samples of the Onakawana lignite from Northern Ontario. These comprised preliminary drying tests in 1930, pulverized fuel tests during 1930 and 1931, tests in a special stoker fired (and hand fired) boiler in 1931, carbonization and briquetting tests in the same year, and special drying tests in connection with a proposed T. & N.O. programme. The results of an intensive investigational programme conducted by the Ontario Research Foundation during 1931 and 1932 are to be found in the annual report for 1933 of the Provincial Department of Mines (6).

Subsequent investigational work (8) was carried out at the Fuel Research Laboratories at Ottawa in 1940 and 1941, comprising drying tests with steam at high pressure and weathering and burning tests on the steam dried lumps. During the same years Fuels Division engineers witnessed burning tests (10) of steam dried lignite and bituminous coals in locomotives and in a stationary boiler of the T. & N.O. Railway.

The results of tests may be summarized as follows:

**Classification**—Lignite, unconsolidated brown coal.

**Analyses**—Run-of-mine carlots—Moisture 52%, Ash 7.0%, B.T.I. (as mined) 5,000, and dry basis 10,420.

	47% Moisture (As Received)	15% Moisture (Partially Dried)
<b>Pulverized Fuel Tests</b>		
B.T.U./lb. as fired . . . . .	5025	9000
Per cent of rated capacity of boiler . . . .	80%	150%
Equivalent evaporation per lb. fuel fired	3.2	6.0

<b>Boiler Tests</b> on special pyramid grates	(33% Moisture Content)	
B.T.U./lb. as fired . . . . .	6850	....
Equivalent evaporation per lb. fuel fired	3.7	....
Equivalent evaporation per lb. standard bituminous coal . . . . .	8.1	....

<b>Domestic Hot-Water Boiler Tests</b> on air dried lumps	(19% Moisture)
Combustion rate; % of rated capacity . . . . .	53%
B.T.U./lb. as fired . . . . .	8350
Lignite used to equal 1 ton American anthracite (tons) . . . . .	1.9



These were the results of tests conducted up to and including 1931 which demonstrated that Onakawana lignite of high moisture content could be pulverized, and burned with an equivalent evaporation of approximately one-third of that of standard bituminous coal, which was raised to two-thirds for 15% moisture content lignite, and that the air dried lumps were serviceable for domestic fuel purposes.

In order to overcome poor weathering and handling properties with serious crumbling and production of fines by exposure to weather, drying by pressure steam as per the Fleissner process, was experimented with (8) to produce more stable lump fuel than obtainable by ordinary air or fuel gas drying. Tests at 200 and 400 pound pressures produced a lump product with 19% and 13% moisture content respectively, the latter with 9750 B.T.U. value having burning properties somewhat similar to Alberta domestic sub-bituminous coal.

Steam dried lignite produced in the experimental drying plant at 100 and 200 pound pressures at North Bay under the auspices of the T. & N.O. Railway Commission were tested (in December 1941 and January 1942) in railway locomotives and also under the T. & N.O. stationary boiler plants. The results of the boiler tests agreed fairly closely with those of former tests at the Fuel Research Laboratories in showing equivalent evaporation per pound of fuel fired values of 3.06 lb. for raw lignite, 4.04 for steam dried lignite (with 35% moisture), 6.68 lb. for mixture one-half raw lignite and one-half Nova Scotia coal, and in comparison with 9.09 lb. for the (Dominion) N.S. bituminous coal alone.

The results of tests in railway locomotives indicated that mixtures of  $1\frac{1}{4}$  parts of steam dried lignite with 1 part of suitable bituminous coal could be used in standard engines hauling tonnage trains with minor structural engine modifications which would allow for operation with bituminous coal alone when desired—the dried lignite analyzing roughly 25% moisture, 7% ash and 8,100 B.T.U.'s.

**Carbonizing and Briquetting**—Early tests conducted at the Fuel Research Laboratories were confirmed by large scale tests in Germany by the Lurgi process. As summarized by Tasker (6a), carbonizing and briquetting with a pitch binder was technically feasible but the costs were uneconomic in northern Ontario. Satisfactory char briquettes of 12,000 B.T.U. (with 13% ash) were made which would compare favorable with briquettes from Saskatchewan lignite char.

In that report (6 and 6a) briquetting without a binder was concluded to be economically attractive but technically impossible at that time. Briquetting tests (7) at high pressure without a binder conducted in the Komarek-Greaves experimental laboratory in Chicago in 1941 produced remarkably good briquettes (with 8,300 B.T.U. value) from raw dried pulverized lignite. These and the results of high pressure tests on Saskatchewan lignite recently conducted by Prof. Piersol at the University of Illinois and witnessed by a Fuels Division engineer are challenging the former conclusion that briquetting without a binder is technically impossible. Despite the fact that binderless briquetting would require under cover storage for the briquettes, it gives good promise of being both technically and economically possible for the utilization of raw lignite fines normally produced in mining operations, and also the fines produced in the steam drying treatment.

## NEW PRESSURIZED COMBUSTION AND CARBONIZATION PROCESSES

The recent application to coal technology of the "Explosion Process" which has been in use for many years in the wood pulp and cereal industries is of particular interest to Onakawana lignite since it offers a means of utilizing low rank (high moisture) coals—being more applicable to fines than to lump coal. This process by which puffed or "shot from guns" cereals are produced consists generally of the charging of the cereal or other raw material into pressure vessels, introduction of low pressure steam, and then their discharge by the rapid release of the pressure.

John I. Yellott\* and A. D. Singh\*\* have developed a "coal atomizer" (14) for pulverizing and drying coal employing the explosion process principle which they claim makes possible the drying and pulverizing of lignite as easily as bituminous coal. In the coal atomizer, super heated steam or warm air under pressure meets a stream of crushed coal at the end of a screw conveyor, and the sudden lowering of pressure as the coal passes through a specially designed nozzle causes particle explosion reactions to produce simultaneous drying and pulverizing. The reported lowering of the moisture content of North Dakota lignite from 37% to 4% under a coal atomizer experimental test suggests that it is indeed worthy of testing this application to Ontario and other Canadian lignites.

The Locomotive Development Committee, a separate and distinct project of Bituminous Coal Research Inc., under the directorship of Mr. Yellott has been intensively active since early 1945 in the development of a new coal-fired gas-turbine railway locomotive. The coal atomizer principle mentioned above is employed to continuously deliver dried pulverized coal under pressure to a "combustor" in which what is termed pressurized combustion takes place. The hot flue gases, after the removal (under pressure) of the fly ash serve to drive the gas-turbine for the direct generation of power. In comparison with Diesel locomotive operation costing slightly over 22c. per locomotive mile including cost of fuel and lubricating oil (the latter at 2.7c. per mile) the operation cost of a coal-burning gas-turbine locomotive is estimated at approximately 8c. per mile which is nearly one-third. In addition to no lubricating oil being required the coal-burning turbine requires no water and claims are made that it will be three or four times as efficient as to-day's coal-burning steam locomotive. It is further stated that the battle of the locomotive fuels, i.e., coal versus oil, will be fought on economic grounds and that coal will have an excellent opportunity to win with the gas-turbine. Since any kind of coal including lignite, and particularly the cheaper fines product, can be used, which coupled with the fact that gas turbines can be operated more efficiently in winter than in summer weather, the subject of the utilization of northern Ontario lignite in the raw or partially dried state as locomotive fuel in that part of the country may well be investigated.

The **Fluidization Process** for the partially devolatilization of coal as experimented with by Singh (15) has features applicable to the utilization of Onakawana lignite. This process, which is reported to have been employed in large scale operations involving fluidized gasification of brown coal in Germany, comprises

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\*Director of Research, Locomotive Development Committee, Bituminous Coal Research, Inc. Baltimore.

\*\*Supervisor, Coal and Gasification Section, Institute of Gas Technology, Chicago.



the reaction of superheated steam on pulverized coal in a suspended fluidized state (i.e., the mixed vapour and solid particles acting as a fluid), to yield the combustible gas similar to water-gas, and a char product with volatile matter content greatly reduced from that in the raw coal feed, and a high yield of primary tar. The finally divided char particles when briquetted would be serviceable for domestic fuel purposes, or it could be utilized for the production of "synthesis gas" for the eventual production of petroleum oil products by the Improved Hydrocarbon Synthesis Process known also as the Improved Fischer-Tropsch Process.

Another process worthy of note here is the gasification process applicable to non-caking sub-bituminous and lignite coals developed by Parry (13) and his associates at the U.S. Bureau of Mines Station at Golden, Colorado. This process now on a small pilot plant scale and which consists of gasifying by the water-gas reaction of coal fed continuously through the annular space between two special metal vertical tubes externally heated is applicable to Okanawana lignite, since it was designed specially for the gasification of non-caking coals. Like the fluidization process it can serve either for complete gasification with gas as a main product or for the production of a char with gas and tar by-products.

## PEAT FUEL AND MOSS

Most of the investigational work on peat fuel by the Division of Fuels was conducted prior to, and during the existence of the joint (Dominion and Province of Ontario) Peat Committee 1918-1922, and is recorded in the final report (17) of that Committee, while the peat moss activities have been mostly since 1940.

The story of endeavours to establish a peat fuel industry in Canada as an auxiliary source of fuel supply in the central Ontario and Quebec "acute" area where shortages of domestic supplies of fuel have periodically occurred, is in many respects similar to that of lignite from northern Ontario. The problem has been and still is how to mine and reduce the moisture content in order that the dried fuel can compete with coals, cokes, and other solid fuels. The fundamental difference between raw peat and lignite, as removed from the ground with 90 and 55% water content respectively, is that peat, as it dries, especially after pulping, forms a coherent mass whereas lignite slacks and becomes quite friable with loss of moisture by crying. However, it is to be observed that irrespective of their physical properties, peat and lignite with the same moisture contents have closely approaching calorific values, and for combustion, carbonization, liquefaction, and total gasification treatment they have much the same characteristics—with peat having lower sulphur content and appreciably higher tar oil yields. Reference (17) contains the results of air drying briquetting, and carbonizing investigations, and in references (2), (3) and (5) are to be found respectively the results of pulverized fuel steaming, domestic fuel, and hydrogenation tests on air dried peat from Alfred, Ontario.

**Peat Moss.** (22) The production of peat moss which has grown into a sizeable industry from 17,000 tons in 1940 to 63,000 tons in 1945 (with a value of \$1,500,000) is mostly all exported to the United States. It is used for stable bedding and poultry litter, for soil conditioning and a filler for commercial fertilizers, and as an insulating and packing material. In 1944 there were six companies in Ontario which produced 9800 tons of moss—the two largest producers being Erie Peat Co., Welland and Canadian Industries Limited, Eriean, near Rondeau Bay on Lake Erie.



## NATURAL GAS

Ontario's natural gas resources, as is well known, are located in the south-western corner of the Province with Sarnia and the Niagara Peninsula as the western and eastern boundaries. As indicated in reference (24) containing the analyses of 198 samples of natural gas from 19 different fields, the higher hydrogen content, i.e., other than methane, ranges roughly from 10 to 20% with heating values varying from slightly below 1,000 to over 1,100 B.T.U. per cu. ft. During the war the supply of gas had to be augmented in certain areas by manufactured gas from coal to meet special war plant demands in addition to city franchise requirements. While natural gas in Texas and other parts of the United States, and Turner Valley (Alta.), surplus gas is a favourite source of synthetic liquid gasoline and other petroleum products by the modified Fischer-Tropsch process, the Ontario gas although a potential source, is generally considered not available for this purpose on account of its relatively high monetary value for city distribution.

## FUELS DIVISION INVESTIGATIONS

The investigational and research projects, comprising the programme of the Bureau of Mines, Fuels Division for the immediate future, are listed below in relation to the Province of Ontario's different fuel resources, viz., Lignite, Coal, Peat Fuel and Moss.

- A. Laboratory (physical and chemical) testing of coals, briquettes, coke, peat, etc.
- B. Physical and Chemical Survey of Canadian coals supplementing and enlarging that conducted in prewar and war periods.
- C. Coal sizing, cleaning, and briquetting investigations, and review of coal preparation and beneficiation methods employed in the United States and other countries. These include briquetting of fines in the raw state from non-caking sub-bituminous lignite coals.
- D. Survey of Canada's (exportable) peat moss resources.
- E. Periodic (news letter) publications reviewing coal technology developments in foreign countries and their application to Canadian fuel problems.
- F. Mechanical coal stoker operation investigation and tests.
- G. Carbonization and other treatment of coals in the powdered form by the new fluidization process for the cheaper production of coke and char than obtainable by present commercial processes.
- H. Pressurized (gas turbine) combustion of powdered coal in stationary and railway locomotive power plants.
- I. Hydrogenation investigations on Canadian coals, heavy oils and bitumen at pressures materially higher than formerly investigated at Fuel Research Laboratories.

### Natural Gas and Crude Oil

- J. Natural Gas—A survey of resources in Western Canada, and collection and analyses of samples from Ontario.

- K. Analysis survey of motor gasoline marketed in Canada.
- L. Petroleum Oils—Collection and evaluation of Canadian crude oils with particular attention to that from the Lloydminster (Sask.) and adjoining Vermillion (Alta.) fields.
- M. Investigation of the amenability of Canadian natural gas and of the various kinds of coals as a source of "synthesis gas" by the new fluidization treatment as feed stock for the production of petroleum oil products and basic chemicals by the modified Fischer-Tropsch (indirect hydrogenation) process.

## SELECTED LIST OF REFERENCES

To accompany "Brief" on Activities of the Fuels Division, Bureau of Mines, in relation to the Fuel Resources of the Province of Ontario, prepared for presentation at meeting of Ontario Research Commission, Toronto, September 12th, 1946.

### References re Onakawana Lignite

- (1) "Analyses of Solid Fuels" (Reprint of Section IV, Part I, Investigations of Fuels and Fuel Testing, 1930 and 1931, pp. 51-91) Mines Branch No. 725-4—1933 (Onakawana Lignite Analyses, pp. 59-62).
- (2) "Comparative Pulverized Fuel Boiler Tests on British Columbia and Alberta Coals and on Ontario Lignite" by C. E. Baltzer and E. S. Malloch, Bureau of Mines No. 790—1938.
- (3) "Boiler Tests on Coals and Other Solid Fuels" (Reprint of Sections I and II, Part I, Investigations of Fuels and Fuel Testing, 1930 and 1941, pp. 17-35), Mines Branch No. 725-3—1933 (Onakawana Lignite, pp. 26-35).
- (4) "Comparative Tests of Various Fuels when Burned in a Domestic Hot-Water Boiler" by C. E. Baltzer and E. S. Malloch, Bureau of Mines No. 802—1940 (Including tests on Onakawana Lump Coal).
- (5) "Tests on the Liquefaction of Canadian Coals by Hydrogenation" by T. E. Warren and K. W. Bowles, Bureau of Mines No. 798—1940 (Coal No. 10 Onakawana Lignite).
- (6) "A Technical and Economic Investigation of Northern Ontario Lignite" (Reprinted from Report of the Department of Mines, Vol. XLII, Part 3 1933).
- (6a) "A Technical Investigation of Northern Ontario Lignite" by C. Tasker (Reprint Transaction of the Canadian Institute of Mining and Metallurgy—1933).
- (7) "Preliminary Tests on the Binderless Briquetting of Northern Ontario Lignite by means of the Komarek-Greaves Process" by E. Swartzman Fuel Research Laboratories, C.S.M. No. 6, June 1941.
- (8) "Investigation on the Drying of Northern Ontario Lignite with Steam at High Pressure" by T. E. Warren, K. W. Bowles, W. Gerrie, and E. Swartzman, Fuel Research Laboratories, Bureau of Mines, 1941.

- (9) "Report on the Burning Characteristics of Semi-Commercially Steam Dried Ontario Lignite" by E. Swartzman, Fuel Research Laboratories, R.I.C.S.—173—February 1942.
- (10) "Burning of Mixtures of Steam Dried Onakawana Lignite and Bituminous Coals in Locomotives and in a Stationary Boiler of the Temiskaming and Northern Ontario Railway in 1941—1942" by R. L. Sutherland.
- (11) "The Onakawana Lignite Deposit Report of the Fuel Commission of Ontario"—March 15th, 1944.
- (12) "Technical and Economic Study of Drying Lignite and Sub-bituminous Coal by the Fleissner Process" by L. C. Harrington, V. F. Parry, and Arthur Koth, U.S. Bureau of Mines Technical Paper 633—1942.
- (13) "Gasification of Lignite and Sub-bituminous Coal Progress Report for 1944", U.S. Bureau of Mines, R.I. 3901—June, 1946.
- (14) "The Coal Atomizer—A New Method of Pulverizing and Drying Coal" by J. I. Yellott and A. D. Singh (Reprinted from Power Plant Engineering, December, 1945).
- (15) "Partial Devolatilization of Coal by the Fluidization Process" by A. D. Singh (Reprint of paper presented American Gas Association, Technical Section, Joint Production & Chemical Committee Conference, Hotel Pennsylvania, New York, June 3-4-5, 1946.
- (16) Coal-Burning Gas Turbines for railway locomotive and stationary power plant purposes—See Reports of Locomotive Development Committee, "Bituminous Coal Research", commencing Volume 3, No. 1, January—March 1945, also Progress Reports of Locomotive Development Committee (No. 3, April 30th, 1946).

#### Reference re Peat Fuel and Moss

- (17) "Final Report of the Peat Committee appointed jointly by the Governments of the Dominion of Canada and the Province of Ontario," by B. F. Haanel, Mines Branch No. 641—1925.
- (18) "Facts about Peat", by B. F. Haanel, Mines Branch No. 614—1924.
- (19) "The Canadian Mineral Industry in 1944", Bureau of Mines No. 185—See similar Annual Reports for previous years and also for 1945 now in the press.
- (20) "Peat in Canada", by A. A. Swinnerton, Canadian Geographical Journal, July 1945, pp. 18 to 29.
- (21) "Peat Moss Deposits in Canada", by H. A. Leverin, Bureau of Mines Memorandum Series No. 80—1941 and No. 83—1943.
- (22) "The Peat Moss Industry in Canada", by A. A. Swinnerton, Memorandum Series No. 90—1946.

#### References re Natural Gas

- (23) "Analyses of Samples of Natural Gas from Ontario in 1932 and 1933", by P. V. Rosewarne and R. J. Offord, Mines Branch Memorandum Series No. 63—July 1934.
- (24) "Analyses of Natural Gas from Ontario, 1932-1939", by R. J. Offord, F.R.L. No. 20, July 1945.



THE COMMITTEE ON EDUCATION AND RESEARCH  
GEOLOGY DIVISION

CANADIAN INSTITUTE OF MINING AND METALLURGY

Professor J. E. Hawley, Chairman

In April, 1946 the Geology Division of the Canadian Institute of Mining and Metallurgy set up a committee on Education and Research to enquire into the ways and means of improving geologic education and training throughout Canada and of promoting geologic research in all its many branches.

A committee consisting of representatives of all Canadian universities, departments of mines, Federal and Provincial, and of the mining industry has been named.

With respect to geologic research the committee has recognized that neither in Canada as a whole, nor in individual provinces is there any central organization engaged solely in studying, correlating and promoting geologic research.

To partially fill this lack, two projects have been undertaken:

1. To assemble information on all available instruments and equipment of the types needed for geologic research of a laboratory type, including chemical laboratories, microscopes, polished section apparatus, spectroscopes, and X-ray diffraction apparatus.
2. To canvas all geologists and determine from them—
  - (a) Research projects at present being studied, and
  - (b) Research problems on which they would like to see work done by others, and for which they themselves have neither the time nor equipment available.

When this information is at hand, it is planned to report the findings to the Institute and make public a list of projects which may be recommended. It is hoped that the actual undertaking of at least some of the projects will be carried out both by officers of various Departments of Mines and by professors and graduate students in universities.

Already many suggestions have been made, including some pertaining to problems in Ontario.

# RESEARCH PROGRAMME—DEPARTMENT OF MINERALOGY, QUEEN'S UNIVERSITY, 1946

Professor J. E. Hawley

## 1. The Synthesis of Certain Minerals

In the belief that a better understanding of the way in which minerals are formed in nature will aid eventually in the exploration for new mineral deposits, experimental work involving the synthesis of several groups of minerals is being pursued in our laboratories.

A considerable amount has already been done on the minerals of the Iron-Nickel-Sulphur group (such as occur at Sudbury) and it is proposed to continue this, enlarging the investigation to include a fourth variable, copper.

Two other groups at present being studied include minerals of the lead-antimony-sulphur group and rare copper and silver selenides.

Investigations of this type include studies of melts, and of precipitates from both acid and alkaline solutions heated in steel bombs. Identification is made positive by X-ray studies of the products formed.

## 2. The Atomic Structure of Crystalline Substances

Under the direction of Dr. L. G. Berry, investigations are being carried on to determine the structural crystallography of many minerals by means of X-rays, particularly of those species not hitherto studied in this manner. The results will form a contribution to Volume II of the new Dana's System of Mineralogy in course of preparation.

Though chiefly of scientific interest, this affords training to graduate students in a highly specialized technique which is essential for the thorough knowledge and final identification of all crystalline substances, including not only minerals but also all metals and their alloys, and all crystalline chemical compounds.

## 3. Joint Research Project on Ontario Feldspar

An investigation of the possibility of separating feldspar from quartz and other minerals with which it is intergrown in many deposits in Eastern Ontario was initiated in 1944 by the Department of Mineralogy with the co-operation of Prof. T. V. Lord, Department of Metallurgy at Queen's University. Flotation and other methods are in use in this respect in other countries, notably in the United States and Germany.

Heretofore production of Canadian feldspar has been from coarse grained, pegmatitic deposits by quarrying operations requiring considerable hand sorting. From these operations recovery has probably been less than 50%. In addition it is known that some such deposits pass vertically downward into finer grained intergrown quartz and feldspar, separation of which is only possible by flotation methods.

Initial experiments have shown that on suitable fresh material a commercial separation of these minerals should be possible.

As Dr. M. L. Keith in the past two summers has been investigating the minerals of Eastern Ontario for the Ontario Department of Mines and has

located other feldspar bearing rocks (syenites) from which it may be recovered by flotation, it is suggested that this project be continued by both him and Professor T. V. Lord and that funds be provided for mill tests to be run on such samples as may be considered promising.

## **The Qualitative Spectrographic Determination of Rare Elements such as and Including Indium, Gallium, Germanium, Thallium, Hafnium and Rhenium and others in Ontario Minerals.**

### **Research recommended to the Ontario Research Commission**

**Purpose**—The purpose of such a study is twofold:

1. To determine what, if any, minerals in Ontario carry significant amounts of any of these rare metals, some of which have highly desirable properties. Some such as Indium are now being used. The availability of others will determine in part their future utilization. When found, more detailed quantitative methods of analysis may be used on available material.
2. To study known ore deposits of various types by this method in order to determine any genetic relation which may exist between ores and igneous rocks associated with them. This is based on the premise that igneous rocks from which ores have arisen will show spectrographically a similar range and number of rare elements as the ore deposits themselves. Such studies should aid materially in further exploration for ore deposits.

### **Scope and Duration of Investigations**

Both spectroscopic studies of the above types might be carried on in one laboratory or in different laboratories.

They will require several years for their completion.

Initial investigations may be commenced on specimens already available in various Ontario Museums and on material which may be supplied by officers of the Ontario Department of Mines. For the second study noted, and later for the first, special collections will need to be made in the field by those supervising the work.

### **Equipment Available and Needed**

Spectroscopic equipment for investigations of the above types are not believed available at present in Ontario for the steady use they would receive in this work. Instruments of this type are in use at the Mines Branch, Department of Mines and Resources, Ottawa, in the Physics Department, University of Toronto. A Hilger E316 Spectroscope is available in the Geology Department at Queen's University, but requires modernizing. Modern spectroscopic equipment suitable for this work will cost approximately \$10,000.00.

### **Personnel**

A full-time technician, who might be trained in this type of routine analytical work would need to be employed at an estimated salary of \$1,800.00 per annum.

Supervision of the work may be referred either to the Ontario Department of Mines or to various mineralogists or geologists in Ontario universities, but in either case a well-integrated programme of research along these lines should be drawn up. Many individual problems may be assigned to graduate students where equipment is made available.



## **GEOPHYSICS RESEARCH**

**Professor J. T. Wilson, Department of Physics,  
University of Toronto**

### **Geophysics at University of Toronto**

Due to the work of Professor L. Gilchrist and his associates of the past 15 years, geophysics has been well established at the University of Toronto. The work is included in the Department of Physics but is closely correlated with that in the Departments of Geological Sciences and Mining Engineering. The co-operation of the Ontario Department of Mines and of several mining and geophysical companies has been of great assistance in providing equipment, scholarships and research problems. There is a separate building for geophysics with a considerable quantity of up-to-date equipment, if not all that might be desired. The staff of the three professors have time for some research and the 30 graduate and 4th year students that took courses last year represent the chief supply in Canada of men trained in geophysics.

### **Geophysical Research**

Cases have been mentioned where geophysical methods were of little use. We need to know more of the limitations of geophysics but it is a young science, and what is remarkable is not the failures but the number of applications that have been found for it and the great use it has been to the oil industry for the past twenty years and the increasing use it is becoming to the mining industry. Only more practice and research will increase the uses and reduce and define the limitations. After all, geology has a useful life of more than a century, but it has been recognized as useful to mining for only a fraction of that time.

Research is of at least two kinds, the search for more knowledge by using existing methods and the search for new and more powerful methods. Physics has made great progress because it has discovered and used a series of new and powerful methods or tools such as electricity, electronics, atomic research. Geology, which is a harder subject to observe and deal with, still chiefly has to depend upon the original method by which a man walks over the ground with a hammer and looks at the outcrops. Geology is an intractable subject and no one can suggest any way of dispensing with this primitive method, by which Dr. G. Hanson has calculated that it will take another four centuries at the present rate to complete a detailed geological map of Canada. Certain aids can be used in the search for minerals such as the use of air photographs and the application of several geophysical methods. Research is needed to develop these.

### **Pre-Cambrian Research**

A better knowledge is needed of the pre-Cambrian Shield and especially of its structure which has partly controlled ore deposition. It is after all probably the largest and richest arc of basement rocks in the world. One might think then that in Canada one should find the greatest knowledge of these rocks, but it is not so. The area is so large that it is far from well mapped; it is so rich that more attention has been paid to developing mines found by prospectors than to discovering the true nature of the shield, which understanding might lead to the discovery of hidden ore deposits. At present the smaller and less rich pre-Cambrian areas of Scotland, Finland and United States are better

mapped and understood. These are not facts of which to be ashamed, since they represent a stage in the development of a young country, but the opportunity should be seized and work begun toward the day when a wider and fuller knowledge of the pre-Cambrian can be obtained, and that knowledge can be used economically. Geophysical methods and air photographs can in the meanwhile help to elucidate pre-Cambrian structure.

### **Airborne Magnetometer**

Of recent developments in geophysics the most striking is the conversion of the magnetic airborne detector (M.A.D.) developed for locating submarines to a continuously recording airborne magnetometer for geological purposes. This instrument, which has been perfected as a result of two years' work by the U.S. Geological Survey, the Bell Telephone Laboratories and the U.S. Naval Ordnance Laboratories, is now capable of giving an accurate record of the vertical intensity of the earth's magnetic field at any height and to a sensitivity of one gramme unit. At the same time a radar altimeter and vertical aerial camera record continuously the position of the plane in three dimensions. One of these equipments was demonstrated in Ottawa by its American crew. Three other M.A.D. units have been loaned to the N.R.C. and after modification should be ready for use. It would seem to be an opportunity for research to procure one of these equipments and try it in Ontario.

The speed obtained by these detectors is a vast increase over previous methods. When the plane flies at 150 m.p.h. an average coverage, deducting time for turns and checks, of 100 miles of magnetic profile can be made in one hour. By present ground methods one instrument can only occupy a very few stations a few hundred feet apart in one hour. With lines  $\frac{1}{4}$  mile apart the new equipment can obtain a contour anomaly map of a 100 square mile township in 4 hours flying time plus a greatly longer time for plotting results. This is a remarkable contrast to the slow compilation of hundreds of commercial surveys that the Geological Survey in co-operation with the N.R.C. Associate Committee on Geophysics is at present undertaking.

### **Rock-burst and Seismic Research**

Another research field in geophysics in Ontario is afforded by the rock-bursts occasionally occurring in certain mines. Although some work has been done, the problem of using seismic equipment to listen for the preliminary noises or microseisms and thus indicate which areas are under great stress and likely to fail by rock-bursts has not been successfully solved. Along with continuing work on this problem there is another of fundamental importance that can be tackled. Each rock-burst is a small earthquake and releases energy waves that penetrate deeply into the earth and return to the surface where they can be detected hundreds of miles away. To understand the structure of the pre-Cambrian shield and the earth's crust deep enough data from geology even in mines cannot be obtained and must come from indirect methods. It seems fundamental to a study of structure and origin of ore that there should be more than a two-dimensional view of the surface of the earth. Seismic studies of rock-burst afford an unusually good opportunity to make such studies for the nature of the whole crust.

In this new science new tools and methods of tackling earth problems are being found. By geophysics the developments in physics to the study of the intractable earth can be made and thus aid the slow method of field geology, but it is a new subject and needs much research in its development.



## **Aerial Photographs and Their Study**

Aerial photographs have now been made of much of Ontario and several million have been made of parts of Canada. Few field geologists will work without them if they can be obtained. Nevertheless the study of them is a specialized job and little literature exists on interpretation. What there is does not often apply to the glaciated and pre-Cambrian areas. During the war it was found useful to give specialist courses on the subject of interpreting aerial photographs for such purposes as finding guns, defences, troops and even of measuring the depth of water over beaches. Courses are needed in use of aerial photographs in geology and we certainly need a collection or list of aerial photographs that illustrate typical conditions in Canadian geology and a text to explain their use is also required.

## **Radar Location of Photographic Planes**

During the war radar techniques called Gee and Shoran were developed by which planes could accurately locate their position. Development is now proceeding at Ottawa towards using such methods for recording the exact position in space of a photographic plane each time it takes an air picture. This may speed plotting, increase accuracy of maps and enable planes to take lines of pictures without gaps and with the minimum of overlap. So large a user of aerial photographs as Ontario could perhaps join in this development research.

## **Uniformity of Geological Maps**

This Commission might set up a sub-committee or take action to make geological maps in Canada more uniform. From province to province or even working in one region the many different scales and conventions used on geological maps are noticed. If these could be reduced and made uniform it would help prospectors and students alike. There could well be a convention as to scales to be used. Of 63 Canadian geological maps recently examined 29 were on 1-inch to 1 mile scale, but the other 34 were on 16 different scales from 100 feet to 1-inch to 20 miles to 1-inch. Admittedly several scales are necessary, but not nearly as many as are used. Again different provinces are issuing provincial maps on scales of 8, 12, 16 and 20 miles to one inch, so that these maps cannot be directly compared.

The shape and size of maps differs also. Quebec often issues maps of geologically interesting blocks, Ontario of townships and Ottawa on a latitude and longitude grid. There is much to be said for each choice but the consistent use of any one would be better than the present diversity.

The colours used for the same formations vary from map to map; perhaps the U.S. method of printing patterns as well as colours is too expensive and there are not enough colours for formations. It would certainly seem possible to arrive at standard conventions for symbols such as faults, shear zones, etc. The costs of printing maps enters into these matters and perhaps complete uniformity can not be reached, but it does seem that considerable simplification could be agreed to if the matter were considered.

## **Mathematical Research in Geology**

When a sufficiently large number of allied observations have been made mathematical methods can sometimes be applied to reduce the many readings to simple laws. In few cases in field geology can enough allied observations be



assembled of sufficient precision to make this approach useful. On the other hand, another use of mathematics is to make certain assumptions which it is agreed are reasonable and from them to show by mathematical methods that more complex and less expected results must follow if the assumptions are true. In a recent book, "The Dynamics of Faulting," Dr. E. M. Anderson of the Scottish Geological Survey has used the second method with remarkable success. He makes reasonable explanations of how the three classes of faulting can arise and what their properties and associations are. He shows why normal faults may be expected to have varying strikes but uniform dips, whereas tear faults have uniform strikes but variable dips, why intrusions are more likely to accompany normal faulting than thrusts, how in the case of tear faults, if the vertical movements are known, the direction of probable horizontal movements can be predicted.

As the collection of accurate facts known about geology accumulates, more opportunities for application of mathematics will arise. Even when mathematics cannot give a complete answer it can often show that some answers are improbable. There is a need to train students in mathematics and physics, since few field geologists once started on their career can find time to discipline themselves to the study of mathematics, but progress in other sciences has been made by more precision and use of mathematics, so presumably progress in geology will follow the same direction.

# THE PROBLEM OF THE CORROSION OF WIRE ROPE

O. W. Ellis, Ontario Research Foundation

There are a sufficient number of variables involved in this problem to make it somewhat difficult. On this account it is proposed that any investigation start with the wire forming the rope, which means that, except that the origin of the wire (type of steel, mill practice, etc.) will generally be known—but that only in general terms, the following variables will be studied and, where possible, controlled.

1. Chemical analysis of **wire**—
  - (a) Usual elements.
  - (b) Unusual elements.
  - (c) non-metallic inclusions.
2. Mechanical properties of **wire**—
  - (a) Tensile properties.
  - (b) Fatigue properties.
  - (c) Hardness distribution.
  - (d) Uniformity of properties along wire length.
3. Structure of **wire**—
  - (a) Microstructure.
  - (b) X-ray structure.
4. **Rope** design and **rope** making practice—
  - (a) What effect has the juxtaposition in a rope of wires varying more or less widely in mechanical properties upon its susceptibility to corrosion? Rarely are ropes manufactured of wire emanating from one lot of steel only. Hence, even in ropes made of wires all of one diameter, it could be assumed that differences in potential within a wire might exist in corrosive situations. Where rope design calls for wires of different diameters, as in mine cable, differences in potential due to differences in properties of adjacent wires are almost certain to exist in corrosive situations and might, therefore, be of some importance in speeding corrosion.
  - (b) What uniformity of properties can be expected of wire ropes? The application of magnetic inspection (non-destructive) to rope as it issues from the rope machines might be considered in this connection. It is not impossible that variations in the properties along the lengths of wires forming a rope may be completely neutralized when these wires are formed into the rope. This problem might be amenable to statistical investigation.
  - (c) What is the role of the lubricant embodied in the core of the rope? What lubricants are presently being used and what new lubricants are available? How can the effectiveness of such lubricants be increased? What are the best core materials available?

In this connection it should be observed that Imperial Oil Limited are prepared to collaborate with Ontario Research Foundation in an attempt to solve this phase of the problem.

- (d) Would the galvanizing of wire be effective in promoting the resistance of ropes to corrosion? How would galvanizing affect the properties of ropes?
- (e) What useful information can be obtained by tests on small ropes in such a test hoist as is already in use at the Foundation? It may be observed that a new and safer test hoist is being designed.

In partial reply to these questions it can be pointed out that—

- (1) Ropes as small as  $\frac{3}{8}$ " diameter and geometrically similar to ropes such as are used as mine cables can be produced for test by rope manufacturers.
- (2) That the combined effects of tensile, bending (stresses due to the passage of rope over the drum) and torsional stresses upon the endurance of  $\frac{1}{4}$ " diameter ropes are brought out in a matter of about ten days with the present equipment. Torsional stresses can be largely eliminated from test ropes by the use of swivels and the effects of tensile and bending stresses alone investigated.
- (3) That the effects of the abuse of wire ropes (lack of lubrication, kinking, overstressing, etc.) can be readily investigated in such a test hoist.
- (4) That local and general changes in the magnetic and other physical properties of small ropes can be readily investigated in such a test hoist.
- (5) That the effects of controlled corrosive conditions can be readily investigated in such a test hoist and that local and general changes due to such conditions can be followed by means of non-destructive magnetic testing equipment.
- (6) That the effectiveness of deterrents to rope corrosion when rope is tested under controlled corrosive conditions can be investigated in such a test hoist.

There are, of course, other factors which need to be taken into account in any investigation of this problem. However, a sufficient number of these factors and probably the most important, have already been referred to. Their investigation will involve considerable time and effort. It seems unnecessary, therefore, to deal with factors of less importance than those already dealt with.



# THE PROBLEM OF THE PRODUCTION OF SPONGE IRON IN ONTARIO

O. W. Ellis, Ontario Research Foundation

At the outset it should be made clear that the problem confronting Ontario is not one of **electric smelting of iron**, which it is understood to be the production of pig iron employing solid fuel as reducing agents and using electric power, but is one of production of **sponge iron**. Such sponge iron would serve as a substitute for "foreign" scrap. The magnitude of the scrap problem is shown by the fact that, at the present time, one Ontario steel company requires between 650 and 750 tons of "foreign" scrap every 24 hours. It is most difficult to find sources of such scrap and a sponge iron plant designed to supply all, or even part, of this scrap would ease the situation considerably. The question resolves itself into an economic one—to supply from 650-750 tons of sponge iron every 24 hours using, for example, pre-heated hydrogen as the reducer, would involve the production of something in the neighbourhood of 15,000,000 cubic feet of hydrogen every 24 hours, i.e., assuming that one was desirous of becoming **entirely** independent of solid fuel.

The production of sponge iron using pre-heated hydrogen—an all-electric process—as the reducer represents one extreme of the problem. The production of sponge iron using solid reducer and gas obtained by the gasification of solid carbonaceous fuel—incidental electricity only—represents the other extreme of the problem. The latter extreme it is not the purpose for discussion here. What it is intended to do is to present some information regarding the production of sponge iron using (a) highly beneficiated (95% iron oxide minimum) ores as the source of the iron and (b) electricity both as the source of heat and as the indirect means of providing a gaseous reducing agent, viz., hydrogen. The problem of producing sponge iron of a degree of purity suitable for its use in the manufacture of steel either in the electric furnace or the open hearth is, then, a twofold problem—

1. Means have to be found for beneficiating the ore, so that the material fed to the reducing furnace shall contain not more than a few, at most say five per cent of gangue, since practically all the gangue will find its way into the sponge iron and will lessen its value to the steel manufacturer. Not more than about 5% (many steel manufacturers might consider this figure too high and would also insist on a maximum of  $1\frac{1}{2}\%$  silica) of gangue is the ideal which should be aimed at, because the cost of slagging off the gangue in a steel-making furnace becomes prohibitive if the gangue is in excess of this figure.

A study must, therefore, be made of means of beneficiating our Ontario ores and of the economics of beneficiation and concentration to 95+ per cent of iron oxide. This part of the problem could best be studied by the Bureau of Mines at Ottawa, who are presently equipped to undertake much of the work involved.

2. While economic means are being investigated to beneficiate various ores so as to provide a 95+ per cent iron oxide for reduction, a study of the low temperature reduction of beneficiated ores should be undertaken.

Reduction of the beneficiated ore can be effected by means of solid or gaseous reducers. Reduction can be carried out in—

1. Rotating kilns.
2. Hearth roasters.
3. By-product ovens.
4. Shafts.

The reduction of finely divided concentrates can be carried out in furnaces of the first three types, but finely divided concentrates must be briquetted and, if necessary, sintered to make them acceptable for treatment in shaft furnaces, in which the reducing gases must have free passage through the shaft. Hence the costs of briquetting and sintering always have to be taken into account when the economics of reduction in shaft furnaces are being studied.

The reduction of finely divided concentrates is fraught with some difficulties.

In the first place, if gangue, even though present in small amounts, is self-fluxing and fuses at temperatures below that most suitable for reduction of the oxide, agglomeration of the concentrates will occur and free access of the reducing gases to the oxide will be prevented. This will be the case whether gaseous or solid reducers are employed.

In the second place, particles of reduced iron tend to weld at temperatures usual in low temperature reduction. Welding is facilitated by pressure, hence great care has to be taken to avoid the agglomeration due to welding under pressure of the reduced iron particles. Agglomeration may lead, on the one hand, to imperfect reduction, and, on the other hand, to blockage of the furnace due to balling-up of the reduced iron.

The **Rotating Kiln** is "far from ideal as a means of contacting active reducing gases (not produced in the charge itself) with granular ore particles. This is particularly true when the product is sticky, as are reduced pyrite cinders. The fundamental limitations of such reduction to the surface layer of the ore bed in the kiln and the probable inability to treat fines in a rotating kiln, while surely not entirely insolvable technologic problems, militate against a facile demonstration of the economic justification of the process and will probably, even in the face of possible modifications of the kiln design and practice, always constitute an unwarrantable spread between the fuel cost, which has been amply demonstrated, and the final cost of production." (See G. Maier, *Sponge Iron Experiments at Mococo*, U.S. Department of the Interior, Bureau of Mines Bulletin 396, Washington, 1936.) It might be added that in all experiments so far conducted with rotating kilns thermal efficiencies appear to have been sacrificed in favour of simplicity of design and rapid output. Little is likely to be gained by further investigations involving the use of equipment of this type.

The **Hearth Roaster** has been applied to the reduction of iron oxide by a number of investigators.

For example, a half-hearted attempt was made in 1912 at the New Cornelia Copper Co., Ajo, Arizona, to prepare sponge iron from calcine obtained by roasting pyrite in a Wedge double-junction furnace. This furnace delivered hot calcine directly to the reducing zone; the three upper hearths were of the ordinary type for roasting sulphide ores and the three lower ones were muffle hearths heated with oil from outside fire-boxes. The experiment failed because the temperature of the reducing zone was too low (500-700°C) and could not be increased without warping or burning out the muffle.



A six-hearth MoDcugall roasting kiln was at one time tried out for the same purpose at Anaconda, Montana, but without success.

In both the above experiments the temperature could not be raised to the point where the ore was reduced to metal without permanently damaging the furnace. In view of the fact that it was furnace design rather than anything else which seemed to cause the failure in these and other earlier experiments it is not altogether surprising that Republic Steel Corporation were willing to install in their new low temperature reduction plant a furnace of the hearth roaster type. "The proposed plant will use the Brassert-Cape low-temperature reduction process and is to have a production of 100 tons of sponge per 24-hour day. The ore to be used will be fine magnetite concentrates produced from Republic's low grade magnetite iron ore mines in New York state. The ore will analyze, on a dry basis, about 68.5% iron (or 94.5% iron oxide in the form of magnetite) and 5.5% gangue material, of which about one-half will be silica. The phosphorus and sulphur contents will both be low. The fuel will be coke oven gas from Republic's new coke oven plant now starting operations at Warren. The gas will contain about 56% hydrogen, will be free from tar products and will be relatively low in sulphur content.

The principal items of plant equipment include a Herreshoff roasting furnace, gas handling equipment and briquetting equipment. The Herreshoff furnace, in which the reduction of the ore takes place, is a multiple-hearth type having twelve hearths twenty feet in diameter. The gas handling equipment includes two desulphurizing units in which the incoming coke oven gas will be further desulphurized to minimize the contamination of the sponge iron product with sulphur; a heat exchanger, in which the spent furnace gases will contribute part of their sensible heat to the incoming gas; a pre-heater, in which the incoming gas will be further heated to the desired temperature; a gas washer, which will clean the spent gases and condense the excess water vapour present in them; a Cottrell precipitator for removing the remaining dust in the spent gas before being returned to the main gas line; and a gas storage tank. The briquetting equipment consists of a set of rolls for compressing the hot sponge iron into suitable size briquettes, and conveyors for dewatering the briquettes and discharging them into the product bins.

The ore will be charged in the top of the Herreshoff furnace and will move continuously downward through the furnace, dropping from one hearth to the next. Ore movement on each hearth will be accomplished by means of blades attached to rabble arms revolving horizontally. As the ore descends through the furnace, the moisture will be driven off and the ore heated to the desired temperature by means of the sensible heat in the up-rising stream of reducing gas. On the lower hearths the iron oxide in the ore will be reduced to metallic iron by means of the hydrogen component of the reducing gas, i.e., the pre-heated coke oven gas entering the bottom of the furnace. The hot sponge iron will be discharged from the bottom hearth of the furnace directly into the briquetting machine, where the material will be compressed into briquettes. This work will be done at low pressures and in a reducing gas atmosphere to prevent re-oxidation of the metallic iron. The briquettes will then be quenched in water and conveyed to the product bins for shipment. The product will contain a small amount of un-reduced iron oxide as it is contemplated to remove only about 90% of the oxygen present in the iron oxide in the ore.

The incoming coke oven gas from the main gas line passes through the desulphurizing units, where the sulphur will be reduced to a few grains per hundred



cubic feet, and then through the heat exchanger and pre-heater will then enter the bottom of the Herreshoff furnace, will reduce the iron oxide to metallic iron on the lower hearths and will pre-heat the ore on the upper hearths. Upon leaving the top of the furnace, the spent gas will pass through the heat exchanger, the gas washer and the Cottrell precipitator and thence to the gas storage tank from which it will be returned to the main gas line leading to the steel mills, where the gas will be used for combustion purposes.

The sponge iron product, containing approximately 88.5% iron, will be shipped to the Republic Steel Corporation's steel plant at Canton, Ohio, where it will be charged as scrap to the electric furnaces. These furnaces require an appreciable tonnage of low carbon scrap free from contamination with alloys, and it is anticipated that these sponge iron briquettes will satisfactorily replace part of the normal scrap charge and thus tend to alleviate, in a small way, the present acute shortage of clean scrap.

Summarizing, this project constitutes a large scale experimental operation for the production of sponge iron and has four distinct factors in its favour: (1) a very high-grade iron ore as furnace feed, (2) a very desirable fuel in the form of coke oven gas, high in hydrogen and low in sulphur, (3) a critical shortage of desirable scrap, thus making the cost of production more of a secondary consideration, and (4) the utilization of the sponge iron product in electric melting furnaces producing a high-grade alloy-free steel that is essential in the war effort." (J. J. Craig; Amer. Gas. Assoc. Monthly, 1943, 25, 4, 147.)

Unfortunately serious technical difficulties have interfered with the successful operation of this furnace. These difficulties are largely connected with the tendency of reduced iron particles to weld at the temperatures usual in low temperature reduction. The effects of such welding have been referred to above (p. 3). Just such effects have been encountered in the operation of the Brassert-Cape furnace, with the result that work at Warren has been abandoned. Even the relatively gentle pressure of rabbles on reduced iron is sufficient to cause its agglomeration.

The **By-Product Oven** was adapted to the reduction of iron ores and concentrates by means of solid reducers, e.g., wood wastes, charcoal, coke, etc., by W. H. Smith of Detroit, who, in the early 30's, operated with some success a plant consisting of five ovens, each of which was capable of producing ten tons of sponge iron per day. Each oven was in essence a shaft furnace, rectangular in plan (10" wide by 15' long) and in vertical cross-section (10" wide and 16' high). In each oven the shaft was divided into three zones. The upper zone, constructed of boiler plate, formed the pre-heating chamber; the centre zone, the walls of which were built of carborundum brick, formed the reducing chamber; the lower one, fabricated of channel formed the cooling chamber. During its passage through the centre zone, the charge was maintained at a reasonably constant temperature, auxiliary heat being supplied thereto by the combustion of oil in flues situated between the ovens. So-called "equalizers" or "equalizing chambers," were interposed between the flues and the ovens. These equalizers served (1) to maintain uniformity of temperature within the ovens and (2) to prevent the temperature of the ovens from exceeding about 1700°F. The major portion of the heat required for reduction, which is an endothermic process, was supplied by the waste gases formed in the reducing zone—the oil burners merely provided auxiliary heat, as mentioned above.

The charge of iron ore and reducing material was introduced into the ovens by means of hoppers. It moved downward through the ovens under the action

of gravity. The column of material in each oven was supported on a plate at the bottom of the furnace. This plate was moved slowly and constantly back and forth in a direction at right angles to the longitudinal axis of the oven. Between the bottom of the cooling chamber and the plate a space of a few inches was allowed through which the reduced ore fell from the furnace. The continuous discharge of reduced iron through this space ensured the descent of the charge. The rate of descent of the charge was in the neighbourhood of 1 foot per hour. Constant movement of the charge was found essential to prevent welding of the reduced material to the furnace walls.

By the time the charge of ore and reducer had reached the centre zone in the furnace it had attained the temperature of reduction. This temperature varied somewhat according to the ores being reduced. Naturally the charge was held at the reduction temperature, i.e., within the centre zone of the oven, for about one and a half hours. When reduction was complete the charge descended through the lower zone, i.e., the cooling zone, where it was cooled by means of air or water. When air was used as the cooling agent the hot air resulting from cooling was used in the combustion flues. Where water was used for cooling the heated water was used in steam boilers.

In the Smith process an excess of reducer was ordinarily employed. On this account the products of reduction were passed over a magnetic drum concentrator to remove the unburned carbon. This unburned carbon was returned to the furnace as part of the reducer for a fresh charge of ore.

It is of interest to note that Smith supported the view that beneficiation of iron was accomplished more readily **after** the reduction of the iron than before. In some opinions this still remains to be proved.

The finely divided sponge iron obtained from the magnetic separation was briquetted. It could be used in this form or could be sintered at about 2000°F if it had to be shipped any great distance.

Smith, in his ovens at Detroit, was using high-grade ore. The briquettes he obtained had an average content of 99%Fe, with less than 0.5%C.

Of processes involving the use of a **Shaft Furnace** the Wiberg is apparently the most successful. A full description of the Wiberg process recently appeared in "Iron Age" (Swedish Sponge Iron—Einer Ameen, Iron Age, 1944, 153, pp. 55-59, 150 (January 20th, 1944) pp. 56-65 (January 27th, 1944)). In view of the availability of information regarding this process it is unnecessary to give details of it here. The fundamental idea behind this process is as follows—"Sintered or lumpy ore, high in iron, is charged into a shaft furnace or other type on the counter-flow principal. In the lower part of the shaft carbon monoxide is introduced at the temperature of 1650-1830°F. While passing through the shaft the gas reduces the ore to iron and in the process the carbon dioxide in the gas rises to 25-30%—corresponding approximately to the equilibrium existing at 1630-1830°F between C, Fe, CO<sub>2</sub> and CO. About 75% of the gas thus formed is evacuated from the shaft by means of a fan and is forced through a carburetor where the CO<sub>2</sub>, in passing through an incandescent layer of carbonaceous material, is converted into carbon monoxide, which is again introduced into the lower part of the shaft. Since the reaction  $\text{CO}_2 + \text{C} = 2\text{CO}$  is endothermic, heat must be supplied to the carburetor. This is done electrically.

That portion of the gas (about 25%) not circulating through the carburetor continuously causes a pre-reduction of the ore, whereby the CO<sub>2</sub> contents of



the gas is further increased. The carbon monoxide still remaining in the gas is finally burned in the upper part of the shaft where air is introduced, thereby preheating the ore to 1650-1830°F. As an excess of air is used in the preheating zone the ore is partially oxidized. Simultaneously a partial elimination of sulphur takes place.

The lower part of the shaft is designed to form a cooling chamber in which the sponge iron is cooled and finally discharged." (ibid).

It is suggested that the attempt be made to adapt a **furnace of somewhat novel design** to meet Ontario conditions. The plan is to combine features of certain types of Hearth Roaster and of the straight-line By-Product Oven in one unit. Using an oven of about the same dimensions as the Smith furnace it would be fitted with a series of, say, 16 ft. long straight-line slightly sloping (from centre line to edges) hearths, set one above the other. The top hearth would be charged from above with powdered ore or concentrates. Communication between this hearth and the next would be provided by two parallel slits extending the full lengths of both sides of the hearth. Through these slits the charge would drop onto the second hearth, the charge being caused to move from the centre to the sides of the top hearth by continuously vibrating the hearth. The second slightly sloping (from edges to centre line) hearth would be provided with a single slit extending the full length of the longitudinal axis of the hearth. Through this slit the charge would be directed to the third hearth and so on downwards, the positions of the slits in the hearths alternately changing from the centres to the outsides of the hearths. In short, each reducing unit would consist of a series of chambers about 16 feet long, of sufficient height to allow the charge to progress down each hearth under the action of vibration and from 12 to 14 inches wide. These chambers would be set one above the other and through them the charge would be made to progress slowly under the action (1) of vibration, and (2) of gravity. The first three or four of these chambers would serve as pre-heating chambers, in the next few reduction would be completed as the charge descended, while the bottom three or four chambers would serve as cooling chambers.

If electrolytic hydrogen were used as reducer, reduction would be brought about by introducing the pre-heated gas into the lowest of the reduction chambers. The hydrogen would pass over and through the descending charge. Most of the water vapour and such excess hydrogen as remained after reduction would be drawn from the system at the top of the reduction zone, passed through the gas washer to condense the water vapour and thence to the pre-heater where it would join the main supply of hydrogen. Enroute to the gas washer most of the sensible heat in the hydrogen and water vapour would pass to the cell room, where it would be electrolyzed to provide more hydrogen. It would, of course, not be the only source of distilled water. Until such time as a use was found for oxygen the latter would go to waste. New uses for oxygen in the steel industry are now being investigated.

The main advantage of using a furnace of the above design would lie in its simplicity. The reduction zone could be built of refractory bricks of standard design, which, when worn, could be replaced readily. The pre-heating and cooling sections could be built in part of refractory brick and in part of steel (plate and section). New units could be erected alongside old units; certain of the refractory walls could, with advantage, be made common to adjacent units as plant expansion was called for. The erection of such furnaces right on ore properties should not be difficult.



Another advantage of the above type of furnace lies in its adaptability to the treatment of finely-divided ore or concentrates. In this respect it is similar to the Brassert-Cape furnace, which also can accommodate finely-divided ores or concentrates.

Yet another advantage of the above type of furnace is that it could be used, when desired, for the reduction of ores and concentrates by means of solid reducers, indirectly as in the Brassert-Cape (producer gas) and Wiberg (carburetted  $\text{CO}_2$ ) processes. In this case part of the gases resulting from reduction would be extracted from the system at the top of the reduction zone and passed either to a washer, etc. (Brassert-Cape) or to a carburetor to be transformed into carbon monoxide (Wiberg). In essence, the furnace would become a shaft furnace.

As an experimental unit this furnace, because of its versatility, seems to have great possibilities. Even as a production unit it seems to offer some advantages over previous designs. It should be noted that the heat of reduction would be supplied, as in the Brassert-Cape and Wiberg processes, by means of a gaseous reducer pre-heated to 1650-1830°F. The main theme is that the furnace operator in Ontario should aim at being, as far as possible, independent both of solid reducer and solid fuel. It is not the writer's intention to discount the value of carbonaceous materials both as solid reducers and as sources of reducing gases. There is absolutely no reason why consideration should not be given to the use of the wastes of our forests resources, nor to overlook the importance of coal and coke in this connection. Two points should be noted, (1) that a very versatile furnace is available for investigation and for probable reduction of sponge iron, and (2) that, if Ontario is to be **entirely** independent of the outside world it has at least 4 sources of reducer and fuel.

1. All electric—

(a) Reducer—pre-heated electrolytic hydrogen.

Fuel—electrical energy supplied to pre-heater.

2. Part electric—

(a) Reducer—producer gas made from waste forest products.

Fuel—electrical energy supplied to pre-heater.

(b) Reducer—carbon monoxide made from waste forest products in electrically heated carburetor.

Fuel—electrical energy supplied to pre-heater.

(c) Reducer—Solid waste forest products.

Fuel—electrical energy applied externally to furnace as, for example, in Smith process.

The use of lignite in conjunction with, or in place of, waste forest products may merit consideration.

It will be clear that, before any large scale operations were started a thorough investigation of the probable cost of producing electrolytic hydrogen on the above scale would have to be made. Dr. Westman of the Ontario Research Foundation has estimated that "For a 3 MM per day capacity plant, operating cells at 2.0 volts and 100 per cent. load factor, the cost exclusive of power was 15.3c/M of total gas; the power cost was equal to the other costs when the a.c. power rate was 0.16c per kilowatt-hour (10.5 \$/h.p. yr.) and was twice the other costs when the a.c. power rate was 0.32c per kilowatt-hour (20.9 \$/h.p. yr.)." These

figures (1930) may require some modification in the light of more recent available information on the subject.

At the same time it is suggested that a small furnace (10 tons Fe/24 hours) be erected of the design suggested above to test out its value as a reducing unit. At first it might be operated on the Wiberg principle, i.e., in conjunction with a carburetor using charcoal as the source of carbon monoxide. Without altering its design in any way the same furnace might later be employed in conjunction with other devices for the production of reducing gas. If necessary, the furnace could be designed initially to allow of its use, when necessary, as a reducer of concentrates with solid reducers. This would involve external heating of the reducing chambers by electrical or other means (vide Smith process).

To sum up, it is suggested (1) that an investigation of the economics of using electrolytic hydrogen as a reducer be undertaken, and (2) that a small pilot plant of novel design, adaptable to various processes, be erected and used in the semi-commercial reduction of Ontario ores and concentrates.

#### RECOMMENDED PROJECTS—MINES, MINERALS AND METALLURGICAL RESEARCH, 1947-48

Title	Agency	Capital	Operating	Total
Iron Ores.....	Ontario Research Foundation.....	\$10,000.00	\$16,000.00	\$24,000.00
Cable Research....	Ontario Research Foundation.....	2,000.00	18,000.00	20,000.00
Unclassified as yet.....				56,000.00
				<u>\$100,000.00</u>

# Ontario Research Commission

## FINAL REPORT

JANUARY

1948

PRINTED BY ORDER OF  
THE LEGISLATIVE ASSEMBLY OF ONTARIO

SESSIONAL PAPER No. 42, 1948



ONTARIO

TORONTO  
PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY





TO THE HON. RAY LAWSON, O.B.E.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to your Honour the Final Report of the Ontario Research Commission.

Respectfully submitted,

D. R. MICHENER,  
Provincial Secretary.

Department of the Provincial Secretary.  
January 6th, 1948.





January 6th, 1948.

THE HONOURABLE D. R. MICHENER,  
Provincial Secretary,  
Province of Ontario,  
Parliament Bldgs.,  
Toronto, Ont.

Dear Mr. Michener:

It is my privilege to transmit herewith the Final Report of the Ontario Research Commission pursuant to Order-in-Council dated August 28th, 1945.

In presenting this report I should like to express the appreciation of the Commission for the assistance they have received in the conduct of their work from the many groups with which they have been associated. They have received whole-hearted support from the members of the various Dominion and Provincial Government departments, the staffs of the universities, individuals and companies in the industrial field, the Canadian Manufacturers' Association and technical groups in Canada, the United States and Great Britain.

I have the honour to be, sir,

Your obedient servant,

ROBT. C. WALLACE,  
Chairman.

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**TERMS OF REFERENCE**  
**ONTARIO**  
**EXECUTIVE COUNCIL OFFICE**

Copy of an Order-in-Council approved by the Honourable, the Lieutenant-Governor, dated the 28th day of August, A.D. 1945.

Upon the recommendation of the Honourable the Prime Minister, the Committee of Council advise that pursuant to the provisions of The Public Inquiries Act, R.S.O. 1937, chapter 19,

Dr. R. C. Wallace	Dr. R. K. Stratford	Dr. T. H. Hogg
E. Holt Gurney	Dr. G. I. Christie <sup>1</sup>	Dr. C. E. Burke, and
Dr. Sidney Smith	H. M. Turner	Dr. W. Sherwood Fox
W. E. Phillips	Dean C. R. Young	

be appointed commissioners to inquire into and report upon all matters concerned with scientific and industrial research as they affect the Province of Ontario and in particular to inquire into and report upon,

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario.

The Committee further advise that Dr. R. C. Wallace be appointed chairman of the Commission and that Professor J. O. Wilhelm be appointed Secretary of the Commission.

And the Committee further advise that the said Commissioners shall have the power to summon any person and require him to give evidence on oath, and to produce such documents and things as the commissioners deem requisite for the full investigation of the matters into which they are appointed to examine, by subpoena signed by the chairman or by any one of the commissioners hereby appointed.

Certified,

C. F. BULMER,  
Clerk, Executive Council.

<sup>1</sup>During a portion of the time Dr. G. I. Christie was unable to attend the Commission meetings on account of illness. Mr. W. R. Reek, President of the Ontario Agricultural College, acted in his place.



## ONTARIO

### EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by The Honourable the Lieutenant-Governor, dated the 23rd day of July, A.D. 1946.

The Committee of Council have had under consideration the report of the Honourable the Provincial Secretary, dated July 18th, 1946, wherein he states that,—

WHEREAS, under the provisions of The Public Inquiries Act, a Commission under the Great Seal bearing date the twenty-eighth day of August, 1945, appointed Dr. R. C. Wallace et al to inquire into and report upon

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario;

AND WHEREAS it is deemed expedient that E. T. STERNE of the City of Brantford should be associated in the said inquiry;

The Honourable the Provincial Secretary therefore recommends that, pursuant to the provisions of the said The Public Inquiries Act, the said E. T. STERNE be appointed a Commissioner for the purposes in the aforesaid Commission contained and recited to be associated for that purpose with the Commissioners therein named, fully and effectually giving and granting unto the said E. T. Sterne all and every the like powers given and granted by the said Commission to the said Commissioners as if the said E. T. Sterne had been appointed by the Commission aforesaid.

The Committee of Council concur in the recommendation of the Honourable the Provincial Secretary, and advise that the same be acted upon.

Certified,

C. F. BULMER,  
Clerk, Executive Council.

# ONTARIO RESEARCH COMMISSION

## GENERAL STATEMENT

On December 4, 1946 the Ontario Research Commission submitted to the Provincial Secretary a report of progress<sup>1</sup>. Since this was purposely made a full and comprehensive statement of the field to be reviewed, of the problems discovered and of the Commission's treatment of these problems, it is possible to cast the Final Report, which is submitted herewith, in briefer and more summary form.

### 1. THE TASK

The task assigned to this Commission is set forth in the terms of reference of an Order-in-Council dated August 28, 1945. This is

"... to inquire into and report upon all matters concerned with scientific and industrial research as they affect the Province of Ontario and in particular to inquire into and report upon,

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario."

### 2. THE COMMISSION'S INTERPRETATION OF THE GOVERNMENT'S INSTRUCTIONS

The Commission conceives it to be its primary duty to convey to the Government its interpretations of the terms of reference just quoted by which the Commission has been guided.

#### Definition of Research

In order that the Government and the Commission may be sure that they are speaking about the same things, they must employ the same terms and definitions. One cannot do better than to adapt, with a few changes, to the situation in Ontario the classification and description of research under the headings of Pure or Fundamental Research, Background Research, and Applied or Practical Research, set forth in a report<sup>2</sup> recently published in Ottawa.

<sup>1</sup>Interim Report, Sessional Paper No. 47, 1947.

<sup>2</sup>Research and Scientific Activity, Canadian Federal Expenditures—1938-1946, Page 11. See Appendix XII.

## General Program

In the first place, the Commission understands that it does not lie within its province to consider the technical problems involved in the detailed planning and conduct of the research efforts encouraged by the Commission. The Commission is concerned, rather, to provide the Government with a program of research which is based upon the best scientific advice available in Canada or elsewhere, and to make certain that this program can be applied directly to the formulation and execution of Government policy. The Commission is also concerned **to recommend to the Government a plan of organization of research which is designed to ensure that the scope and balance of the program are such as will direct the application of scientific knowledge and effort into those fields which offer the brightest promise of yielding returns of permanent value to the Province, that the funds made available are adequate and proportionate to needs, and that such funds are used to the best advantage.**

The report which the Commission submits herewith is to be regarded as "final" only in the sense that it is the final report of this Commission as such. The entire experience of the Commission leads it to share fully, in reference to Ontario, the view recently expressed in Great Britain by a highly competent authority on research:<sup>1</sup> "... It is too early to decide what the ideal Government organization for research should be. The organization for fostering scientific research must remain for many years in a state of active development." Consequently, it would be most harmful to the public interest to regard this report as ideal, since manifestly the suggested program will of necessity be subject to a process of evolution.

### 3. WHAT THE COMMISSION HAS ACCOMPLISHED

(a) **General Statement.** The experience of the Commission and what it has accomplished up to the present constitute a basis on which are built the recommendations the Commission submits in this report. The facts involved are set forth here at first in a general statement.

1. In the early months of its service the Commission succeeded in bringing together most of the leading workers in each field of scientific research in Ontario. This is the first time in the history of the Province that this result has been achieved.

2. Through the numerous conferences that ensued between the Commission and the scientific workers the Commission was able to initiate an active and practical system of co-ordination of effort in and among the several fields of research in the Province.

3. One result of these conferences was that they supplied the Commission with materials out of which the Commission constructed in a number of fields programs of research which were undertaken immediately: in some fields these programs consist of extension of investigations already under way and in others of entirely new endeavours. This work during the fiscal year '47-'48 will involve expenditures in the various research fields of approximately

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<sup>1</sup>Government Research and Development in Great Britain—Nature, Sept. 20, 1947, page 379; Sir Edward Appleton, British Commonwealth Scientific Conference, London, 1946, Report of Proceedings, Cmd. 6970, page 15.



\$300,000.00. The work is under competent direction of research workers in the universities and the Ontario Research Foundation.

4. The diverse experiences and observations of the Commission have afforded the material required as a foundation on which the Commission can now construct a continuing permanent plan for the organization of research effort in Ontario, a plan which the Commission can confidently recommend to the Government as promising to achieve the purpose set forth previously in this report.<sup>1</sup>

5. From the outset the Commission studied with care the existing and prospective facilities for the training of research workers in order to ascertain whether they were adequate to meet the needs. In the light of the limitations revealed by the study the Commission, even in its first year of service, recommended the establishment of a system of fellowships as the first and indispensable step towards providing for the training of a competent personnel. During the present academic year the Government provided an appropriation of \$50,000.00. 58 students have been assisted by scholarships to a total of \$44,275.00. The profitable experience afforded by the operation of this system has prompted the Commission to recommend it as a necessary instrument of permanent policy.

(b) **Expanded Statement.** The obvious first step of the Commission was to determine the several fields of scientific research with which the Province is concerned. The Commission has held twenty-two meetings, some of which extended over three days. Individual members of the Commission in addition have attended meetings of the Advisory Committees and on occasion have acted as Chairmen to them in the preliminary stages of their organization. The personnel of the Advisory Committees is given in the Appendices. The administrative office at 43 Queen's Park has been the centre for almost daily informal meetings of research men. Special efforts were made to keep visiting scientists in touch with the activities of the Commission by arranging visits and conferences.

## Various Fields of Research

A careful survey revealed that the fields which stand out with marked individuality are:

- Agriculture
- Fisheries and Wildlife
- Forestry (Production and Utilization)
- Industry (both large and small)
- Mines, Minerals and Metallurgy
- Soils
- Highways<sup>2</sup>
- Industrial Wastes<sup>2</sup>
- Aerial Surveys.<sup>2</sup>

<sup>1</sup>See Page 2, supra.

<sup>2</sup>These are of a more general character in that they overlap in some degree upon one or more other fields.

## Committees and their Work

In order to secure the fullest possible amount of authoritative data upon research in all these fields, the Commission has instituted in each field a Committee composed of persons who are best acquainted with that field. Since a Committee includes, in addition to workers in scientific research, representatives of both federal and provincial departments charged with the administration of natural resources, as well as representatives of interested industries, the Commission is convinced that the representation thus provided is satisfactorily comprehensive. For the guidance of each Committee its function has been clearly outlined by the Commission:

- (a) to survey its specific field thoroughly;
- (b) to report to this Commission such facts as it may find regarding the status of the research in that field, and, further, to report upon the existing facilities and trained personnel required;
- (c) to recommend the means for applying scientific knowledge.

By means of this division of duties among the several Committees the Commission has been able to attain two results of primary importance:

- (a) a manageable co-ordination of the great volume of diverse material submitted by the Committees;
- (b) a clear conspectus of the real problem and of the active program required in the whole territory of research in Ontario.

The Main Advisory Committees have held approximately 40 meetings, the Sub-Committees 20, and Executive Committees held 17 meetings. Most of the meetings were held in Toronto but some were held in other places in the Province which are of special interest to the particular committee concerned. This permitted discussion of local problems, since interested scientists in the area were invited to sit with the Committees.

The research activities under the Committees are too numerous to list or to describe here, but a few examples outlined briefly will indicate the way in which the committee system functions.

1. The Committee on Mines, Minerals and Metallurgy set up a sub-committee to investigate the problem of mine cable or wire rope. This sub-committee with the co-operation of the Ontario Research Foundation has begun work, is preparing a general bibliography and is fabricating a variety of different ropes under controlled conditions. These ropes will be put into service and accurately observed during their period of use. Concurrently, apparatus is being constructed which will test ropes in the laboratory under plant conditions.
2. Another problem of the same Committee has to do with the production of sponge iron from Ontario ores. As a step in the investigation, fifty-five tons of Steep Rock ore was sent to Sweden and put through a Wiberg furnace. A report on the progress of this work is being prepared.
3. The Committee on Fisheries and Wildlife has initiated an important and comprehensive program on Lake Erie. The program comprises a study of (1) chemical conditions of the water in regard to oxygen, carbon dioxide,

acidity, alkalinity, silica, nitrogen and phosphorus content; (2) physical conditions of the water in regard to temperature gradients and light penetration; (3) microscopic plant and animal populations; (4) the nature of the lake bottom; and (5) the spawning and early growth of the commercially valuable fish.

## **Scholarships**

The system of scholarships instituted by the Government of the Province and administered by the Commission has already proved its worth and should be continued. It enabled the Commission even in the first year of its existence to assist many promising students and to inaugurate several very important research projects. As the system continues to function the numbers and quality of skilled scientists will be rapidly enhanced.

In 1947 fifty-eight scholarships have been provided amounting in all to a value of \$44,275.00. The students are at all stages of their graduate courses and the distribution among subjects and the universities is shown in Appendix X.

## **Economics and Statistics**

From the outset the Commission has conferred frequently with the Ontario Bureau of Statistics and Research and with the Economic Research Branch of the Department of Reconstruction in Ottawa. This association has been of great value in revealing the intimate connection that often exists between scientific research and economic research, and has emphasized the fact that frequently it is advisable to make an economic survey before undertaking a research.





#### 4. RECOMMENDATIONS

Your Commission recognizes that decisions on matters of general policy concerning scientific and industrial research must remain a function of Government, such decisions to be reached through the medium of a Cabinet Committee or through such other means as the Government may find most appropriate. Your Commission respectfully submits the recommendations which follow:

##### **Permanent Advisory Council**

- (a) That a permanent Commission or Advisory Council<sup>1</sup> be set up to continue to guide the research activities of the Province in such a way as to take advantage of the organization and undertakings already instituted by the present Commission.

The Commission conceives the chief functions of the Council to be:

##### **Advise Government as to relative needs for aid**

1. to advise the Government as to the financial aid required to carry out each successive annual program of research; also to correlate all research projects supported by the Government with a view to ensuring that the amount of research devoted to the various kinds of the Province's natural resources and the moneys appropriated therefor be distributed in just proportion among them;

##### **Welcome advice from all sources**

2. to receive and weigh representations from any authoritative source within the Province concerning the needs of research in all fields;

##### **Advise various interests as to best means of investigation**

3. to advise the Government as well as industrial and other interests, according to the needs of either or of both, in their selection of the most satisfactory means of undertaking specific research projects;

##### **Research information**

4. to institute some form of service, either independently or in co-operation with other agencies, as the Council may deem best, to promote the distribution of information concerning research and its results, especially information pertinent to the various interests of Ontario; and also to assist in the preparation and publication of appraisals of scientific information not available through the usual channels.

##### **To encourage co-operation between Government and Industry**

5. to institute some form of co-operative research in which industry and the Government participate in financial support in some such form as obtains in the Industrial Research Associations of Great Britain;

<sup>1</sup>The proposed permanent or Advisory Council will from this point onwards be referred to as the Council.

## Scholarships

6. to assist, through the maintenance of a system of scholarships and other approved means, in providing, on an increasing scale proportionate to requirements, for the training of a competent research personnel;

## Reports

7. (i) to provide the Government periodically with comprehensive reports which set forth clearly the progress of the research activities within the Province;

(ii) to encourage the publication, chiefly for the information of the general public, of sober factual statements, cast in non-technical, readable language, of the research activities sponsored by the Council, the purpose of such publications being to preclude unwarranted expectations of greater and speedier results than can be justified.

## Committees in all fields of research

(b) That in each major field of research there be instituted a Committee composed of representatives of all important divisions of the field, the function of the Committee being to assist the Council in the discharge of its functions by:

1. maintaining a continuous survey of the needs and developments in its field;
2. keeping the Council informed concerning the findings of the surveys;
3. reporting to the Council the Committee's judgment as to allocation of approved research projects, and also as to estimates of the amounts of money required to support them all and severally;
4. assisting in assembling, analysing and interpreting information relating to the field of each Committee's particular competence.

## Statutory grants (c) Finances.

1. That the Government assure the Council of the provision each year of a minimum statutory grant of funds; this is required to meet the expenses of:

- (i) the full time executive office of the Council and the Committees;
- (ii) the expenses of the Council and the Committees;
- (iii) maintaining annual scholarships, and special "grants-in-aid";
- (iv) securing the uninterrupted support of long-term research projects not otherwise provided for;



- (v) such service or services as may be set up to provide for the publication of reports and the distribution of information regarding research.

### **Annual appropriations**

2. The Commission regards it as obvious that annual grants, some appropriated expressly to meet the cost of short-term projects, and others to enable the Council to respond promptly to emergent situations in reference to research, will also be required.

### **Responsibility for administration of finance**

3. The Commission holds the view that the administration of the finances involved in the support of programs recommended by the Council is logically the function of a Department of Government and not of the Council.

### **Special nature of research**

As the Commission proceeded in its investigations it became more and more aware that the unique nature of true research is a factor that must always be borne in mind if the object of research is not to be imperilled. Research is veritably a "sensitive plant" in the realm of higher human endeavours. Hence, the strict application of a rigid administrative system to some kinds of research work may, through creating an atmosphere inimical to the conduct of research, cause great waste of time, money and effort. Flexibility should be allowed to the degree that affords the greatest freedom compatible with safety. Flexibility is important in securing the right man for the right job and in the financial control of the project which has been entrusted to him. The Commission hopes that the Council whom the Government may appoint to succeed the Commission will make provision to review the situation periodically in order that such freedom and flexibility are maintained as a practice.

## **5. GENERAL OBSERVATIONS ON GOVERNMENT AND INDUSTRIAL RESEARCH AS APPLIED TO ONTARIO**

### **Provincial Government has a responsibility for research**

In the light of its long and comprehensive survey of the conditions obtaining in regard to scientific research the Commission clearly sees the reasons why the responsibility for supporting a large program of research rests upon the Government of Ontario.

1. In the first place, Canada is too large a country to warrant it entrusting the whole program of scientific research solely to one organization.
2. The more modest proportions of the Province offer the conditions that promise more rapid progress in certain kinds of research. The control over the natural resources of the Province are a constitutional responsibility of the Province. Research into better methods of improving and utilizing the natural resources is also a provincial responsibility.

3. Ontario is the largest and most highly industrialized of the provinces; by reason of her distinctive geographical situation and the vast variety of her resources, she has a large number of research problems that are peculiarly her own.

The Commission, therefore, holds it to be a normal function of the Government of the Province to take a leading part in promoting, co-ordinating and supporting financially an extensive program of approved effort in this broad realm. The program covers many fields which, though lightly overlapping upon each other in some instances, are nevertheless to be regarded for practical purposes as separate. The measure of the responsibility of government in each field should logically be deduced from the measure of the importance of each field, both absolutely and relatively, in the economic and other interests of the people.

### **Dominion-Provincial Division of Funds**

In order that expenditures for research be allocated in proper proportion as between the Dominion Government and the Provincial Government, it is imperative that an active liaison be maintained between the two governments. The Commission is of the opinion that if the most effective benefits from research are to be assured, each research unit should be close to the ultimate beneficiary. In order to make sure that the highest degree of co-ordination obtains between the two governmental agencies it will be necessary in the case of each project to determine carefully at the outset and to re-examine frequently thereafter the division of responsibility for conducting the investigation concerned and for the provision of the funds supporting it. It is a matter for profound regret that at present statistics on governmental expenditures for research are very indefinite and are compiled on a diversity of bases. Hence they do not permit one to make more than very general statements on their authority, nor even to make comparisons among them that have any meaning of value. As prevailing vaguenesses are abated, in like proportion will the division of responsibility for conducting and financing certain kinds of research become more sharply defined.

### **Proportion of Government Aid**

The amount of financial aid for research provided by all agencies, including the Government of the Province, and, hence, the sum of the research efforts made possible by this aid, fall very far short of meeting the host of existing needs.

The deficiencies in research facilities and activities in Ontario which the Commission has found in its survey are thrown into high relief when compared with the statistics in regard to research under other governmental jurisdictions. It is not possible to arrive at a fair comparison. Some figures quoted are: 8/10 of 1% of national income in Britain, 1% projected in U.S.A. and an estimated 1% in Russia. In agriculture in Ontario with a productive value of more than \$400,000,000.00 only \$300,000.00 is being spent on research this year.<sup>1</sup>

<sup>1</sup>See Appendix XI.

## **No unnecessary duplication**

The Commission has found through the activities of the Committees that there is no wasteful duplication of research.

One must not assume, however, that there should never be any duplication of research effort. On the contrary, certain special problems may arise in the investigation of which positive advantage may be gained if several workers are undertaking concurrent research directed to the same end. The inevitable differences among the workers in regard to points of view, knowledge, experience and technique, would promise a more exacting testing of methods and results, and, possibly, also hasten the attainment of objectives.

## **Personnel**

The supply of trained personnel is far below the number needed to carry on the program of research for which financial support is available even now.

That the existence of a sufficiently large and highly trained staff is the prime prerequisite to carrying out successfully a worth-while program of research is patent to everybody. There are occasions when improvised physical facilities may serve satisfactorily but only when at the same time there is the trained staff to direct the improvising. But personnel can never be improvised, since there is no substitute whatever for the highest type of skill and training involved. It is of the utmost importance not only that the number of scientists be adequate but also that they be distributed among the several fields of research in proportion to the relative needs of these fields. It will be one of the duties of the Council to determine at the outset the nature and extent of all physical facilities required, and the numbers and composition of the personnel needed to carry out the programs of research outlined. This will enable the Province to maintain material and personnel at proper levels.

## **Universities chief training school of personnel**

The duty of providing a trained research personnel rests chiefly with the universities. The Commission is fully aware that it is without authority to recommend financial expenditures other than those required for the support of research. Nevertheless, it believes it to be its duty to call attention to the existence of an unavoidable combination of factors, one of them being outside the Commission's purview, upon whose internal balance hinges the success or failure of any large scale program of research. These are, in order of importance and timing: the universities, the research force, the investigation, the results. These are like a row of children's building blocks: if the first falls, all the others fall in sequence. If the universities are without sufficient means to train increasing numbers of research workers, the force will be hampered, research will languish, results will be scanty and disappointing, because Ontario will be unable to keep her position in relation to the rest of the world.

## **Government department training**

The policy of offering to university graduates and undergraduates summer employment under departments of government in activities involving actual research endeavour affords sound practical training in certain fields.



At present the influences that have the greatest effect in retarding enlistment in the ranks of research workers in Ontario are two: (a) uncertainty as to the probability of finding enough openings for employment in Canada in the fields in which the candidates are trained; (b) the glaring fact that at the same level of employment and of the workers' scientific training the scale of salaries in Canada is lower than that obtaining in the United States. This adverse effect would be appreciably offset if the Government would soon adopt a general policy of expanding the employment of scientists.

## **Distribution of technical information**

A great part of scientific knowledge which has resulted from research would be of great value to the Province if it could be more fully utilized.

It would seem to be a duty of the Council to devise and progressively to evolve some systematic means whereby such scientific knowledge can be made more readily available than it now is for those to whom it may be of benefit. True, Canadian scientific and technical workers are not entirely without sources of this kind of information; for example, the Technical Information Service of the National Research Council, the research services of the Ontario Research Foundation, the libraries of universities, industries, scientific institutes and a number of co-operative associations. But useful as these are, they are not as useful as they would be if there existed some medium designed to co-ordinate all avenues of access to their combined resources and the resources of all other services. The need is great and the task of meeting it is difficult, though, if the problem is studied thoroughly, not impossible.

## **Natural resources**

All the investigations undertaken by the Commission have without exception led the Commission to the unqualified conviction that a greatly increased financial support of research on the part of the Government is imperative. In certain fields—Forestry, Fisheries and Wildlife, Soils, Mining and Agriculture—this is especially obvious because of the deplorable and widespread economic effects caused by an excessively rapid consumption and destruction of natural resources in these fields.

The fact that the Governments of Great Britain and the United States are vastly increasing their expenditures for research in the field of natural resources is ample proof of their conviction that research is a vital necessity if their resources are to be adequately developed.

## **Industry**

A large number of the big industries have long been operating extensive research laboratories of their own and are steadily increasing their annual appropriations for that purpose. This fact the Commission regards as the most convincing single proof that profit can be derived from scientific research.

## **Small industries**

A very real problem lies with the small industries. Many of them are unaware of the import of scientific research; to many the idea has never occurred that science has any practical bearing upon their businesses; many

firms are so small that they are unable either to set up laboratory research facilities of their own or to support fellowships in a public research institute.<sup>1</sup> Such firms are without defence against the penalties that result from obsolete processes and products. It is as much the duty of government to aid in providing the needed defence for small industries and their dependent communities as it is in other fields. However, the method of providing aid of this type is different, difficult and slow, as it was at one time in Great Britain. The Commission is fully persuaded that the same kind of result that has been achieved in Great Britain can be achieved here through the co-operative effort of industry and government.

The Commission in its Interim Report recommended that the facilities of the Ontario Research Foundation be expanded to include an industrial advisory service. With the co-operation of the Canadian Manufacturers' Association, the Trade and Industry Branch of the Department of Planning and Development and the Ontario Research Foundation, it was possible to begin this service in July of 1947 under the title, Ontario Industrial Research Service.

The Industrial Research Committee of the Commission is planning, in addition, a program designed to promote a greater measure of co-operation within individual industrial fields with a view to the solution of the problems common to each field. This program is receiving the energetic support of the Canadian Manufacturers' Association, the Department of Planning and Development and the Ontario Research Foundation.

### **Ontario Research Foundation**

The industrial economy of the Province requires an ever increasing application of science to its operations. The demands for scientific assistance are greater even than in wartime. The Ontario Research Foundation is gearing itself to serve a broader field and needs adequate financial support on that account.

### **Government contribution to research**

In this report the Commission includes a program of research in each field which the Commission believes it profitable to undertake<sup>2</sup>. Every project in these programs has been selected in the light at once of general needs and relative urgency. The Commission is fully aware that the adoption of the recommendations to support research programs of the scale and scope described and at the same time to provide for the training of an ever increasing force of skilled personnel, will commit the Province to a progressive annual expenditure under the title of research which will greatly exceed that made in any past year. The ripest reflection can lead only to the conclusion that if the Province is determined to make the best possible use of its resources and sees clearly that organized research supported by the Government is the only known avenue leading directly to that end, the Province cannot avoid assuming the obligation. It is the price that must be paid for the enhancement of the people's welfare and prosperity through the proper use of our Province's natural heritage of potential wealth.

<sup>1</sup>See Annual Report of the Ontario Research Foundation, 1945, page 7.

<sup>2</sup>See Appendix I-IX.

But what assurance has one that there will be worth-while return from the investment which the Commission counsels the Province of Ontario to make in research? Happily, one can offer a positive and most encouraging assurance, an assurance drawn direct from the Allied Nations' experiences in war. So great is Britain's confidence in it that even in this time of economic distress she boldly supports her research program for this year by voting an unprecedented appropriation—£67,000,000 on general account and, in addition, £11,000,000 for research in the universities. The reason for Britain's exemplary faith in research is set forth clearly in a statement made a year ago by Sir Edward Appleton, Secretary of the British Government's Department of Scientific and Industrial Research; it may be quoted here with eminent appropriateness:<sup>1</sup>

"The speed at which development was carried through in wartime made it easy to trace cause and effect, and to see how the final product was related to the efforts of the research worker. The public has thus had a complete demonstration of what science—variously applied—can achieve, and has come to realise what it may expect from science in peacetime. Accordingly the public wants to be assured that the facilities and resources in this country both for fundamental and applied research are adequate, that industry is ready to use the results of research, and that the intimate and fruitful collaboration between science and industry established in the war will be continued."

*See original article*

<sup>1</sup>Industrial Research, 1946, Todd Publishing Company Limited, London and New York, p. 33.



## APPENDIX I.

### FISHERIES AND WILDLIFE

#### Committee:

Prof. J. R. Dymond (Chairman)	Royal Ontario Museum of Zoology.
Dr. A. M. Fallis (Secretary)	Ontario Research Foundation.
Prof. C. E. Atwood	Zoology, University of Toronto.
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen.
Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests.
Prof. A. F. Coventry	Zoology, University of Toronto.
Mr. E. C. Cross	Royal Ontario Museum of Zoology.
Dr. H. W. Curran	Biology, Queen's University.
Dr. F. E. J. Fry	Zoology, University of Toronto.
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests.
Mr. L. Hughes	Ontario Tourist Trade Association.
Prof. F. P. Ide	Zoology, University of Toronto.
Dr. W. H. Johnson	Zoology, University of Western Ontario.
(Substitute: Dr. H. Battle)	Zoology, University of Western Ontario.
Dr. R. R. Langford	Zoology, University of Toronto.
Mr. H. H. MacKay	Ontario Dept. of Lands and Forests.
Mr. K. M. Mayall	Ontario Dept. of Planning and Development.
Mr. Tom C. McCall	Ontario Dept. of Travel and Publicity.
Mr. W. Austin Peters	Ontario Federation of Anglers and Hunters.
Dr. N. W. Radforth	Botany, McMaster University.
Mr. Lester L. Snyder	Royal Ontario Museum of Zoology.
Dr. A. Emerson Warren	Zoology, McMaster University.
Prof. J. O. Wilhelm	Ontario Research Commission.

#### Meetings:

November 10th, 1945	Ontario Research Foundation, Toronto.
December 1st, 1945	Ontario Research Foundation, Toronto.
April 6th, 1946	Parliament Buildings, Toronto.
August 19th, 1946	Queen's University Biological Station, Chaffey's Locks.
October 4th, 1946	Royal Ontario Museum of Zoology, Toronto.
November 9th, 1946	Royal Ontario Museum of Zoology, Toronto.
March 22nd, 1947	Royal Ontario Museum of Zoology, Toronto.
October 4th, 1947	Royal Ontario Museum of Zoology, Toronto.
November 29th, 1947	Royal Ontario Museum of Zoology, Toronto.

## Sub-Committees:

### Technical Session, 1948

Dr. F. E. J. Fry (Chairman)	Zoology, University of Toronto.
Dr. A. M. Fallis	Ontario Research Foundation.
Mr. C. David Fowle	Zoology, University of Toronto.
Dr. A. B. James	Toronto East General and Orthopaedic Hospital.
Dr. A. Emerson Warren	Zoology, McMaster University.

### Publicity

Mr. E. C. Cross (Chairman)	Royal Ontario Museum of Zoology.
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen.
Mr. L. Hughes	Northern Ontario Outfitters' Association.
Prof. F. P. Ide	Zoology, University of Toronto.
Dr. W. H. Johnson	Zoology, University of Western Ontario.
Mr. K. M. Mayall	Ontario Dept. of Planning and Development.
Mr. L. L. Snyder	Royal Ontario Museum of Zoology.

## FISHERIES AND WILDLIFE RESEARCH IN ONTARIO

### General Position in the Economy of Ontario

Ontario's fisheries and wildlife are two resources which, while at present in the category of "wasting" resources, could be maintained at a reasonably permanent level. That they are important resources is generally accepted. It could not be otherwise, since ninety per cent of the Province is blessed with one or both of them, and fifty per cent of the Province will produce no other crop than they now produce. They provide a direct annual income of some five million dollars a year to commercial fishermen and trappers, who are the primary producers for a number of secondary industries. They provide the chief attractions for the host of tourists who spend in the Province an estimated hundred million dollars a year, an expenditure which makes possible the employment of a number of people in direct service, and which is the main support for the industries engaged in the manufacture of sporting equipment. Thus they represent an abundant source of exports, provided we realize that Nature's beneficence is not unlimited, and that our privilege of exploiting these tremendous gifts involves the duty of conserving them. Aside, too, from purely monetary considerations is the fact that they afford to many of our own citizens excellent facilities for recreation, a matter of considerable importance to general welfare.

### Government Responsibility

The maintenance of these resources is, of course, left almost entirely to the Government. Since their nature is such that they are exploited for pleasure or for profit by thousands of individuals, no private groups or corporations are in a position to assume as much responsibility as they would where exploita-

tion by a few might be directed by commercial common sense, with a view to permanence. Then, too, since the Government derives directly from these resources a large revenue—approximately a million dollars a year—it should be responsible for the proper husbanding of them.

## **Present Methods of Conservation**

That that responsibility has been accepted is borne out by the efforts of the Government to protect both fisheries and wildlife. There have been legal restrictions on the lengths of the hunting and fishing seasons, on the size and the number of the fish taken, and on the number of birds or animals shot. There has been complete protection for some species and there has been considerable re-stocking of game fish and birds. These efforts have modified the effects of too rapid "mining" of these two great resources, but yet are quite inadequate to provide a complete solution to the problem of constant depletion. They are inadequate, not because they are in themselves useless, but because other factors in the environmental factors of fish and wildlife—settlement, cultivation of the soil, deforestation, construction and destruction of dams, and the pollution of water with sewage and industrial wastes—may be detrimental to the purpose motivating our present efforts. These other factors cannot be ignored and any comprehensive long-term program aimed at correcting the basic causes of depletion must be based on adequate knowledge of all the favourable and unfavourable factors.

## **Present Situation**

To date biological research is wholly inadequate to provide the information necessary for the proper administration of Ontario's fisheries and wildlife resources. As a matter of fact, aside from the collection of valuable data made by the Royal Ontario Museum of Zoology over a period of years, there has been no systematic investigation of terrestrial wildlife in the Province. As a result our legislation and our practices have been based more on opinion than on scientific knowledge. The present bounty on "wolves" may be defeating its real purpose—that of deer protection, and it is not unlikely that agriculture may be paying a considerable penalty for our constant warfare against hawks, owls, skunks, weasels and foxes. Even the lowly forest mouse may provide an administrative riddle, for, while it is known to occupy a prominent place in the diet of our fur bearing animals, its depredations may be deterring forest regeneration or may equally well be controlling some insect pests by eating their larvae.

While fisheries research is in a much happier position, historically, it is still too woefully inadequate to justify much confidence. We are still without reliable data concerning the capacity of waters to maintain a stock of fish, as regards either population or species, and we are without complete information regarding many important environmental factors for all species.

## **The Requirements**

While there are sufficient organizations to undertake an adequate program of research, they are, at least in the cases of the universities and the Ontario Research Foundation, badly handicapped by limited and obsolete facilities as well as by a shortage of personnel. To a large extent research on fisheries



and wildlife has had to be relegated to a position of minor importance, to an uncertain and disjointed existence, with recurrent revivals when space, time, and money permitted. In such circumstances there can be little doubt that much of the value of the work accomplished was lost.

The immediate needs may be summarized as follows:

1. Provision of Personnel:

- (a) The establishment of scholarships with a view to encouraging graduate work in the field of fisheries and wildlife.
- (b) The institution of a policy of employment preference for scientifically trained personnel in the administration of these resources to offer further encouragement to students in these fields.
- (c) The institution of a policy of employment preference for undergraduates in these fields in temporary summer appointments for purposes of administration.

2. Extension of Facilities and Staff:

- (a) Queen's University—Further extension of the laboratory at Lake Opinicon and future extensions to cover work in Lake Ontario.  
Research personnel.
- (b) University of Western Ontario—Extension of present program in Lake Erie.  
Research personnel.
- (c) McMaster University—Additional facilities for investigations on the Dundas marshes and Lake Ontario.  
Research personnel.
- (d) University of Toronto—Laboratory with space far beyond what exists at present.  
Research personnel.
- (e) Departments—Additional facilities and personnel in the Provincial Parks and River Development Areas and extension of projects contemplated.
- (f) Ontario Fisheries Research Laboratory.  
Research personnel.
- (g) Ontario Research Foundation—Extension to other fields than Parasitology.
- (h) Royal Ontario Museum of Zoology.  
Additional staff.

# RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
<b>MCMASTER UNIVERSITY</b>				
1. The Ecology of the Muskrat in the Dundas Marsh and Surrounding Territory. (A. E. Warren).	McMaster; Royal Botanical Gardens; Dept. of Lands and Forests; Hamilton Angling and Hunting Assn.; Royal Ontario Museum.	\$ 450.00	\$ 1,645.00	\$ 2,095.00
2. Limnological Investigation of the Dundas Marsh and Adjoining Waters. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ontario Fisheries Research Laboratory; Hamilton Dept. of Health.	298.00	1,665.00	1,963.00
3. An Ecological Survey of the Birds of Wentworth County, with particular reference to Water-Fowl. (A. E. Warren).	McMaster; Royal Botanical Gardens; Hamilton Angling and Hunting Assn.; Hamilton Nature Club; The Federation of Ontario Naturalists; Dept. of Lands and Forests; Dept. of Mines and Resources; Royal Ontario Museum of Zoology.	430.00	965.00	1,395.00
4. The Ecology of the Fishes in the Dundas Marsh. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ontario Fisheries Research Laboratory; Ont. Dept. of Lands and Forests; Hamilton Angling and Hunting Assn.; Hamilton Harbour Commission; Royal Ontario Museum of Zoology.	492.00	1,965.00	2,457.00
5. The Mosquito Problem and its Biological Control. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ont. Dept. of Lands and Forests; Hamilton Dept. of Health; The Desplaines Valley Mosquito Abatement District, Lyons, Illinois.	650.00	1,790.00	2,440.00
6. Life History of the Carp. (A. E. Warren).	McMaster; Royal Botanical Gardens; Dept. of Lands and Forests; Ontario Fisheries Research Laboratory; Royal Ontario Museum of Zoology.	310.00	805.00	1,115.00
7. Study of Aquatic Insects of the Dundas Marsh.	McMaster; Royal Botanical Gardens.	357.00	1,795.00	2,152.00
8. The Mammalian Fauna of Wentworth County. (A. E. Warren; L. A. Prince; H. Eyd; M. Inksetter).	McMaster; Royal Botanical Gardens; Hamilton Angling and Hunting Assn.; The Hamilton Nature Club; Offices of the County Clerk and Local Townships; Royal Ontario Museum of Zoology.	350.00	2,335.00	2,685.00
Forward.....		\$3,337.00	\$12,965.00	\$16,302.00

# RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
McMASTER UNIVERSITY—(Cont'd.)	Brought Forward.....	\$3,337.00	\$12,965.00	\$16,302.00
Director's travel and other expenses.	.....		200.00	200.00
Library Purchases.	.....	100.00		100.00
9. Ecological Investigations on Soil Micro-organisms. (J. J. Miller; N. W. Radforth).	McMaster; Royal Botanical Gardens.	500.00	2,000.00	2,500.00
10. Soil Resources in Relation to Micro-floral Studies. (N. W. Radforth; L. Laking).	McMaster; Royal Botanical Gardens.	100.00	600.00	700.00
11. Floristic Survey of the Eastern Portion of the North Shore of Lake Erie, including Rondeau Park and Turkey Point. (N. W. Radforth; L. O. Gaier).	McMaster.	500.00	3,200.00	3,700.00
12. Taxonomic and Ecological Survey of Plant Life in Cootes' Paradise Area of Royal Botanical Gardens. (N. W. Radforth).	McMaster; Royal Botanical Gardens.	500.00	1,200.00	1,700.00
QUEEN'S UNIVERSITY BIOLOGICAL STATION				
13. Migration, Rate of Growth and Population Studies on the Bass. (H. W. Curran).	Queen's University.	850.00	960.00	1,810.00
14. Creel Census. (H. W. Curran).	Queen's University.	50.00	650.00	700.00
15. Experimental Verification of Natural Hybridization Between Species of Sun-fishes. (H. W. Curran).	Queen's University.	500.00	1,030.00	1,530.00
Forward.....	Forward.....	\$1,400.00	\$2,640.00	\$4,040.00



# RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
QUEEN'S UNIVERSITY BIOLOGICAL STATION—(Cont'd.)				
16. Aquatic Invertebrates as a Source of Food for Fish. (H. W. Curran).	Brought Forward. Queen's University.	\$1,400.00 100.00	\$2,640.00 756.00	\$4,040.00 856.00
17. Limnological Survey of Lake Opinicon. (H. W. Curran).	Queen's University.	200.00	1,450.00	1,650.00
Publishing of Reports.	.....		300.00	300.00
Clerical Assistance.	.....		320.00	320.00
Purchase of Books.	.....	150.00		150.00
UNIVERSITY OF WESTERN ONTARIO				
18. Study of Ecological Factors of Lake Erie most likely to have influence on fish population.		\$1,850.00	\$5,466.00	\$7,316.00
Equipment.....				
Maintenance.....		5,950.00		5,950.00
Salaries.....			3,110.00	3,110.00
Miscellaneous.....			4,340.00	4,340.00
			3,600.00	3,600.00
UNIVERSITY OF TORONTO				
19. Caloric Requirements in Lake Trout. (F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	\$5,950.00	\$11,050.00	\$17,000.00
		200.00	800.00	1,000.00
20. Movement of Lake Trout in Relation to Temperature. (F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	200.00	800.00	1,000.00
21. Quantitative Methods of Plankton Collection. (R. R. Langford).	Ontario Fisheries Research Laboratory.		1,350.00	1,350.00
22. Relation of Dissolved Minerals to Rate of Growth and Reproduction of Algae. (R. R. Langford; F. E. J. Fry).	Ontario Fisheries Research Laboratory.	1,000.00	2,350.00	3,350.00
Forward.....		\$1,400.00	\$5,300.00	\$6,700.00

# RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
UNIVERSITY OF TORONTO—(Cont'd.) 23. Penetration of Light into Water. (R. R. Langford).	Brought Forward ..... Ontario Fisheries Research Laboratory.	\$1,400.00 500.00	\$5,300.00 1,350.00	\$6,700.00 1,850.00
24. Supply and Fate of Chemical Nutrients in Lakes and the Chemical Analyses of Organisms. (R. R. Langford; F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	600.00	1,050.00	1,650.00
25. Bibliographic Research. (F. E. J. Fry; R. R. Langford; F. P. Ide)	Ontario Fisheries Research Laboratory. .....		2,600.00	2,600.00
Organization of Ontario. Fisheries Research Laboratory Library.			2,000.00	2,000.00
26. Lethal Limits of Temperature in Stream Insects with Special Reference to their Thermal History. (F. P. Ide; F. E. J. Fry).	Ontario Fisheries Research Laboratory. .....	100.00	1,000.00	1,100.00
27. Measurement of Environmental Factors such as humidity, Temperature, Light under Terrestrial Conditions. (A. F. Coventry).	.....	300.00	1,100.00	1,400.00
28. Toxicity Problem	.....			
		\$2,900.00	\$14,400.00	\$20,650.00

# **RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)**

Title	Participating Agencies	Capital	Operating	Total
ROYAL ONTARIO MUSEUM OF ZOOLOGY				
29. Natural History Survey of Cape Henrietta Maria. (J. R. Dymond).		1,000.00	5,400.00	6,400.00
30. Wildlife Food Habits Research. (J. R. Dymond).		500.00	3,250.00	3,750.00
31. Reference Collection of Animal Parasites. (J. R. Dymond).			2,500.00	2,500.00
32. Compilation of Animal Population Records. (J. R. Dymond).			500.00	500.00
33. Lake Erie Fish Populations			3,000.00	3,000.00
34. Lake Herrings of the Great Lakes.			200.00	200.00
		\$1,500.00	\$14,850.00	\$16,350.00
			26,975.00	26,975.00
			\$26,975.00	\$26,975.00
ONTARIO RESEARCH FOUNDATION				
35. Parasitology.				





## APPENDIX II.

### SOILS

#### Committee:

Dr. H. B. Speakman (Chairman) . . .	Ontario Research Foundation.
Mr. L. J. Chapman (Secretary) . . .	Ontario Research Foundation.
Mr. G. A. Hills . . . . .	Ontario Dept. of Lands and Forests.
Mr. R. N. Johnston . . . . .	Ontario Dept. of Lands and Forests.
Dr. A. Leahey . . . . .	Central Experimental Farm, Ottawa.
Prof. F. F. Morwick . . . . .	Chemistry, Ontario Agricultural College.
Mr. E. F. Palmer . . . . .	Horticultural Experiment Station, Vineland.
Mr. F. L. Peckover . . . . .	National Research Council.
Prof. D. F. Putnam . . . . .	Geography, University of Toronto.
Mr. A. H. Richardson . . . . .	Ontario Dept. of Planning and Development.
Prof. G. N. Ruhnke . . . . .	Soils, Ontario Agricultural College.
Prof. W. L. Sagar . . . . .	Civil Engineering, University of Toronto.
Mr. J. Walter . . . . .	Ontario Dept. of Highways.
Prof. J. O. Wilhelm . . . . .	Ontario Research Commission.

#### Meetings:

November 2nd, 1945 . . . . .	Ontario Research Foundation, Toronto.
April 4th, 1946 . . . . .	Ontario Research Foundation, Toronto.
July 3rd, 1946 . . . . .	Ontario Agricultural College, Guelph.
Sept. 23rd, 1946 . . . . .	Horticultural Experimental Station, Vineland.
May 22nd, 1947 . . . . .	Ontario Research Foundation, Toronto.
September 10th, 1947 . . . . .	Municipal Building, Cochrane.

### SOILS RESEARCH IN ONTARIO

#### Interested Groups

Perhaps in no other field is there a greater need for a co-ordinated long-term program than in that of soils. Soils are of vital concern to Agriculture, and that concern is reflected in the activities of the Dominion and Provincial Departments of Agriculture. Soils data are key factors, and are recognized as such, in the work of the Ontario Department of Lands and Forests, the Ontario Department of Planning and Development, and the Ontario Department of Highways. Information on soils is of assistance to the Department of Mines and to those charged with the administration of game and fisheries. The work of the Ontario Research Foundation on Physiography and Climatology would be much more useful in an intelligent land-use program if correlated with an accurate and complete study of the soils in the Province. Such a study would be of tremendous value to educational groups in the teaching of geography. The importance of soils in the general economy is further attested by the recent setting up of the Associate Committee on Soil and Snow Mechanisms within the National Research Council.

That each of the interested groups has done valuable work in this field is a matter of record; that there has been little, if any, duplication is rather amazing. This situation is due, no doubt, to the splendid co-operation which has existed. There is every reason to expect that the various groups would continue the present practice of mutual help and understanding, but, with the growing need for the immediate extension of our knowledge of soils throughout the whole Province, there can be no doubt that a program, planned and carried out by all, would meet the needs of each not only much more rapidly, but at considerable financial saving over a period of years.

It is apparent, then, that there is every opportunity for mutual help and co-ordinated effort on the part of the various groups concerned with the problem of soils. How best this can be promoted remains to be considered. Recommendations to this end were prepared by the Advisory Committee on Soils Research and are listed here.

## **Recommendations**

### **For Co-ordination and Direction of Soils Research:**

1. The establishment, on a permanent basis, of a central organization to co-ordinate a general program of research for the Province and to advise the Government thereon.
2. The establishment, by this organization, of an advisory committee on soils, its purpose being:
  - (a) to submit plans for the co-ordination of all soils research in the Province;
  - (b) to submit estimates of the cost of the suggested program;
  - (c) to correlate the data arising out of this research and to submit the results to the central organization;
  - (d) to advise the central organization on all matters pertaining to soils research, including such considerations as research personnel, scholarships, publications, etc.

## **General Program of Projects**

1. The establishment of a greater number of scholarships to attract students to the field of Soils, with a view to correcting the present deficiency of qualified personnel in this field;
2. Renewal and extension of the program of Soils Survey, with a view to the complete mapping of the Province at the earliest date possible and to recognizing the particular urgency of the study of the soils in the northern clay belt;
3. Assistance to permit an expansion of activities in the fields of Climatology and Physiography, and the correlation of existing data in these studies with the data obtained in Soils Surveys;
4. The expansion of the program of the mapping and land-use direction of individual farms;



5. The encouragement of the co-operative study of fertility requirements and crop adaptation of various soil types;
6. Extension of the work on forest fixation, soils colloids and soil fertility;
7. Extension and encouragement of the work of river-valley development;
8. Provision for the inauguration of a program of waste-land reclamation and forest regeneration based on accurate information regarding the soils in the areas concerned.

### Special Projects

The projects listed below have been selected because they involve fundamental problems bearing upon ultimate land-use, and because, at the present time, no systematic large scale work is being done on any one of them.

Some of these projects offer an excellent medium for co-operative research on the part of two or more institutions or departments, and can be broken down readily into sub-projects suitable for graduate students in several fields.

1. Physico-Chemical properties of Ontario soils affecting the erodability of important soil types;
2. A study of the physical, chemical and mineralogical character of the clays in the major soil types;
3. A study of water-borne sediments and soil nutrients in rivers as a measure of soil erosion losses from a watershed;
4. The rate of infiltration of rainfall into soils as related to run-off;
5. The distribution of cobalt, manganese and iodine in soils and crop plants in relation to the incidence of deficiency diseases in livestock;
6. An investigation of the sulphur content of the precipitation in various localities in relation to additions of sulphur to the soil.

### RECOMMENDED PROJECTS—SOILS RESEARCH—1948-49

Title	Agency	Capital	Operating	Total
Physiography	Ontario Research Foundation	\$ 1,300.00	\$ 22,425.00	\$ 23,725.00



## APPENDIX III.

### AGRICULTURE

#### Committee:

Mr. C. F. Luckham (Chairman)	Norfolk Specialty Farms.
Mr. Ken Betzner	Farmer, Waterloo.
Dr. H. D. Branion	Animal Nutrition, Ontario Agricultural College.
Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College.
Prof. E. H. Garrard	Bacteriology, Ontario Agricultural College.
Dr. E. S. Hopkins	Central Experimental Farm, Ottawa.
Mr. Lawrence Kerr	Farmer, Chatham.
Prof. R. G. Knox	Animal Husbandry, Ontario Agricultural College.
Dr. A. L. MacNabb	Ontario Veterinary College.
Mr. M. H. McCurdy	Cockshutt Plow Company Limited.
Dr. G. P. McRostie	Field Husbandry, Ontario Agricultural College.
Dr. K. W. Neatby	Science Service, Dominion Dept. of Agriculture.
Mr. E. F. Palmer	Horticultural Experiment Station, Vineland.
Mr. A. Pitt	Massey-Harris Company, Limited.
Mr. F. W. Presant	Feed Division, Toronto Elevators Limited.
Prof. G. N. Ruhnke	Soils, Ontario Agricultural College.
Mr. G. A. Schell	Canada Packers Limited.
Mr. J. C. Steckley	Western Ontario Experimental Farm, Ridgetown.
Mr. W. G. Toner	Royal Dairy Products, Charles Yeates & Co. Ltd.
Mr. S. B. Trainer	Silverwood Dairies, Limited.
Mr. George Wilson	Ontario Dept. of Agriculture.
Mr. S. M. Young	International Harvester Company of Canada Ltd.
Prof. J. O. Wilhelm	Ontario Research Commission.

#### Meetings:

July 9th and 10th, 1946	Ontario Agricultural College, Guelph.
September 9th, 1946	Ontario Agricultural College, Guelph.
December 16th, 1946	Ontario Agricultural College, Guelph.

#### Sub-Committees:

##### Co-ordination

Dr. H. D. Branion (Chairman)	Animal Nutrition, Ontario Agricultural College.
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Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College.
Mr. C. F. Luckham	Norfolk Specialty Farms, St. Williams.
Mr. E. F. Palmer	Horticultural Experiment Station, Vineland.
Mr. George Wilson	Ontario Dept. of Agriculture.
Dr. E. S. Hopkins (advisory)	Central Experimental Farm, Ottawa.
Dr. K. W. Neatby (advisory)	Science Service, Dominion Dept. of Agriculture.

The report upon Agriculture requires a special preface. To understand clearly the present state of research in this field one must not fail to note that it is somewhat different from that obtaining in any of the other fields that have to do with natural resources. In Agriculture the need for a steadily expanding program of research is just as urgent as it is elsewhere, but the efforts of the workers to carry out such a program have been impeded by a peculiar combination of circumstances.

It is in this fact that one may see the reason why the Committee on Agriculture offers in this report no definite recommendations for an extended scheme of research. The Committee realizes the utter futility of making any recommendation of this kind at a time when it is obvious that the Ontario Agricultural College cannot assume an increased volume of work. The quality of the work done at the College and the competency of the staff are of the highest. But the unprecedented load of teaching now carried by the staff and their willing response to countless requests for extension and other services, are spreading out their store of energies so thin that the program of research they are craving to undertake is of necessity suffering. The effect of the paucity of research results is not felt keenly now, but in the event of a general economic recession the lack of new scientific knowledge of use to agriculture would be disastrous.

In the opinion of the Commission the situation constitutes a real problem which calls for an immediate endeavour to co-ordinate afresh the efforts of all the agencies concerned. The approach to the task should not be made in the spirit of adverse criticism of present effort. On the contrary, it should be co-operative and directed to working out without delay a plan whereby shortages of personnel in two departments in particular—extension and teaching—may be removed. Such a result would afford the competent research workers the freedom to devote a generous measure of their time, skill and energies to the great task of research for which they have been trained.

## Beginnings of Research

Immediately after Confederation the Dominion Parliament embarked on a regular program of agricultural service, and within twenty years had set up numerous divisions, each charged with the responsibility for research and extension in a particular field. During the same period provincial programs of research and extension were developing just as rapidly and just as efficiently. For the most part, the provinces worked through the provincial universities, colleges and foundations, through agricultural representatives and through producers' organizations or individual producers. The work accomplished over the years has won for provincial Departments of Agri-

culture and their associates prestige and prominence equivalent to that enjoyed in the industry by the Dominion Department of Agriculture, and, while it is impossible to enumerate the contributions made, it should be pointed out that those contributions were particularly important in the fields of soils problems, crop production, animal production and the marketing of farm products.

**Special Feature of Agricultural Research**

The notable feature in agricultural research, a feature which sets it more or less apart from research in other fields, is that activity commonly known as extension work, which must be an integral part of practically every project. Since knowledge gained in the laboratory, the college plot or the experimental farm is of value only when made known to the "practical farmer", and since the vast majority of these are rugged individualists, the agencies interested in agricultural welfare and progress must carry on their extension work constantly.

**Types of Research**

Agricultural research, to be worthwhile, must cover the basic needs of production and of utilization. Research on production is well-established, and existing facilities could be expanded to meet the needs in this field, which includes soils surveys and proper land-use, plant production and improvement and animal production and improvement, each with its host of related topics and its extension program.

Far less attention has been paid to utilization. Of late years the needs in this field have been recognized and some start has been made on an overall program. It is recognized that the Dominion Government has a primary responsibility in this field, and is much better-equipped to promote the proposed campaign, but considerable contribution might be made by the Province. The importance to any industry of the utilization of its products requires no elaboration, and since agricultural production represents the work of hundreds of thousands of individuals, research leading to the maintenance of markets for that production must, of necessity, be a public responsibility. That research, which must be a major effort, includes the whole problem of markets with all the ramifications of world-trade problems, facilities for marketing, storage, transportation, processing, industrial utilization of farm products and nutrition. It includes, as well, research on land-settlement, farm credits, stabilized prices, farm labour, together with consideration of farm amenities and cultural activities. Agriculture, to be permanently progressive and remuneratively attractive, must be efficiently productive in regard to both quality and quantity of its products. It follows, surely, that agricultural research must have continuity and must be attractive to qualified personnel.

**RECOMMENDED PROJECTS—AGRICULTURAL RESEARCH—1948-49**

Title	Agency	Capital	Operating	Total
Industrial Utilization of Agricultural Products.	Ontario Research Foundation	\$ 2,000.00	\$ 18,000.00	\$ 20,000.00





## APPENDIX IV.

### MINES, MINERALS AND METALLURGY

#### Committee:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association.
Prof. H. S. Armstrong	Geology, McMaster University.
Prof. E. L. Bruce	Research Geology, Queen's University.
Prof. O. A. Carson	Metallurgy, Queen's University.
Dr. O. W. Ellis	Ontario Research Foundation.
Dr. C. S. Evans	Union Gas Company of Canada, Ltd.
Dr. G. S. Farnham	The International Nickel Company of Canada Ltd.
Dr. D. L. H. Forbes	The Teck-Hughes Gold Mines, Ltd.
Mr. T. W. Hardy	Climax Molybdenum Company.
Prof. J. E. Hawley	Mineralogy, Queen's University.
Prof. L. M. Pidgeon	Metallurgical Engineering, University of Toronto.
Prof. G. H. Reavely	Geology and Geography, University of Western Ontario.
Mr. H. C. Rickaby	Ontario Dept. of Mines.
Mr. R. H. Rimmer	Aluminium Laboratories Ltd.
Mr. W. Samuel	Steep Rock Iron Mines Ltd.
Mr. G. M. Thomson	General Engineering Company of Canada.
Mr. W. B. Timm	Dominion Dept. of Mines and Resources.
Dr. C. R. Whittemore	Deloro Smelting & Refining Co. Ltd.
Dr. G. E. Willey	Algoma Steel Corporation, Ltd.
Prof. C. G. Williams	Mining Engineering, University of Toronto.
Prof. J. T. Wilson	Physics, University of Toronto.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario.
Prof. J. O. Wilhelm	Ontario Research Commission.

#### Meetings:

September 12th, 1946	Parliament Buildings, Toronto.
November 15th, 1946	Parliament Buildings, Toronto.
May 28th, 1947	Parliament Buildings, Toronto.
November 21st, 1947	Parliament Buildings, Toronto.

#### Sub-Committees:

##### Ferrous Metallurgy

Dr. O. W. Ellis (Chairman)	Ontario Research Foundation.
Mr. P. E. Cavanagh (Secretary)	Ontario Research Foundation.
Mr. T. W. Hardy	Climax Molybdenum Company.
Mr. F. A. Loosley	Dominion Foundries and Steel Ltd.
Mr. W. Samuel	Steep Rock Iron Mines, Ltd.

Mr. R. J. Traill.....	Dominion Dept. of Mines and Resources.
Mr. D. G. Watt.....	The Hydro-Electric Power Commission of Ontario.
Dr. G. E. Willey.....	Algoma Steel Corporation, Ltd.
Mr. R. B. Young.....	The Hydro-Electric Power Commission of Ontario.

### Wire Rope

Dr. O. W. Ellis (Chairman).....	Ontario Research Foundation.
Mr. I. A. Usher (Secretary).....	Ontario Research Foundation.
Mr. N. B. Brown.....	Dominion Dept. of Mines and Resources.
Mr. R. E. Dye.....	Dome Mines Ltd.
Mr. A. C. Halferdahl.....	National Research Council.
Mr. R. Healey.....	Wright-Hargreaves Mines Ltd.
Mr. D. T. Morris.....	Canada Wire & Cable Co. Ltd.
Mr. J. G. Morrow.....	Steel Company of Canada Ltd.
Mr. R. Parker.....	International Nickel Co. of Canada, Ltd.
Mr. N. F. Parkinson.....	Ontario Mining Association.
Mr. R. S. Segsworth.....	General Engineering Co. (Canada) Ltd.
Mr. D. G. Sinclair.....	Ontario Department of Mines.
Mr. L. W. Sproule.....	Imperial Oil Limited.
Mr. R. B. Young.....	The Hydro-Electric Power Commission of Ontario.

Both the Federal and the Provincial Governments have long recognized a considerable responsibility for the encouragement of the mining and metallurgical industries.<sup>1</sup> The importance of these industries in the economy of Ontario<sup>2</sup> makes their stability a matter of major concern to Provincial authorities, not only from the standpoint of social welfare but from that of revenue. And ownership of the mineral resources imposes on the Province the primary responsibility for their careful utilization.

There are two essentials for continuing stability in these industries. Since mineral resources are irreproducible they should be exploited with the minimum of waste, and since all properties must ultimately become exhausted there must be a continuous and systematic search for new ore bodies. Obviously the processing of ores currently being raised will receive the most careful scrutiny by those working with them. But the task of an inventory of untapped ore bodies—whether untapped because of complexity of ores or because they are still undiscovered—must be undertaken by the Government for obvious reasons.

To both these ends—more efficient recovery and a reliable inventory—research is necessary. Methods of processing of ores currently unprofitable must be sought. A complete inventory will be possible only through the discovery of new prospecting tools. To be successful today prospecting must

<sup>1</sup>For a complete statement of the work done by governments to 1933, see: Federal: Canada, Department of Mines, 1933.

Provincial (Ontario): The Mining Laws of Ontario and the Department of Mines, (T. W. Fisher, 1933).

<sup>2</sup>See figures submitted in the Report of the Royal Ontario Mining Commission, 1944.

enlist the aid of the chemist and the geophysicist as well as that of the geologist. The current tools of geophysics are the comparatively crude ones of a science just becoming established, but a science which promises to be one of greater and greater value in mineral inventory work.

There are several metallurgical problems which merit immediate research. Some of these are as follows:

1. The better utilization of iron ores and fuels;
2. The recovery of apatite from crystalline limestone;
3. The discovery and recovery of radioactive and rare earth minerals;
4. The extraction of aluminum from the complex ores on Parry Island;
5. The greater development of the non-metallic (industrial) minerals;
6. The discovery of alternative sources of fuel supply;
7. The cataloguing and analysing of the results of previous research to make accessible information already in existence but now quite inaccessible.

The first of these problems, the better utilization of iron ores and fuels, seemed of sufficient urgency to justify immediate action. For that reason an investigation directed by the Ontario Research Foundation was initiated by the Commission. A second project, one concerning the manufacture and use in practice of mine hoisting ropes, was also instituted. While it, too, is directed by the Ontario Research Foundation, it is essentially a co-operative undertaking on the part of the Government, the Foundation, the mines, and the manufacturers of wire rope. It should be noted here that in both these projects close liaison is maintained with the Federal Department of Mines through representatives of the latter on each of the project committees.

Facilities for mining and metallurgical research seem reasonably adequate at the present time. The Federal Bureau of Mines is particularly well equipped to do research of a public, semi-public or private nature. The Foundation is in a similar position. These laboratories can be supplemented by those of the various universities. The present policy of the Provincial Department of limiting its direct research efforts to the field of Geology, while sponsoring other projects using the facilities mentioned is a commendable one. The Geological Branch has rendered considerable service in the assessment of existing tools of geophysics, the inadequacy of which has seemingly handicapped it. It is still further handicapped by the multiplicity of methods used in the geological mapping by Provincial and Dominion services. Ontario might well give some leadership in the establishment of some uniformity so that existing information might be more readily accessible.



# RECOMMENDED PROJECTS—MINES, MINERALS AND METALLURGICAL RESEARCH—1948-49

	Participating Agencies	Capital	Operating	Total
<b>UNIVERSITY OF TORONTO</b>		\$	\$	\$
1. Geothermal Studies (A. D. Misener).	Ontario Department of Mines; Mining industries.	700.00	2,300.00	3,000.00
2. Magnetic Studies. (A. A. Brant).	Ontario Department of Mines; Mining industries.	1,000.00	2,000.00	3,000.00
3. Radioactive Studies. (J. T. Wilson)	Ontario Department of Mines; Mining industries.	450.00	2,550.00	3,000.00
4. X-ray Diffraction Research (M. A. Peacock)	Ontario Department of Mines.	3,870.00	3,197.00	7,067.00
		\$ 6,020.00	\$10,047.00	\$16,067.00
<b>QUEEN'S UNIVERSITY</b>				
5. Spectrographic Research. (J. E. Hawley).	Bureau of Mines, Ottawa.	\$15,000.00	\$ 5,000.00	\$20,000.00
<b>ONTARIO RESEARCH FOUNDATION</b>				
6. Wire Rope Project. (O. W. Ellis, I. A. Usher).	Ontario Department of Mines; Bureau of Mines, Ottawa; Mining industries.	4,250.00	23,200.00	27,450.00
7. Reduction of Ferrous Ores. (O. W. Ellis, P. E. Cavanagh)	Ontario Department of Mines; Bureau of Mines, Ottawa; Mining industries.	5,750.00	16,350.00	22,100.00
		\$10,000.00	\$39,550.00	\$49,550.00
<b>McMASTER UNIVERSITY</b>				
8. Geochemical Studies (H. S. Armstrong).	.....			\$ 5,000.00
				\$90,617.00

## APPENDIX V.

### FORESTRY

#### Committee:

Dean J. W. B. Sisam (Chairman)	Forestry, University of Toronto.
Prof. C. E. Atwood	Zoology, University of Toronto.
Mr. A. B. Baird	Dominion Parasite Laboratory, Belleville.
Dr. John E. Bier	Dominion Laboratory of Forest Pathology, Toronto.
Mr. W. Boyd Campbell	Pulp and Paper Research Institute of Canada.
Mr. G. G. Cosens	Kimberly-Clark Corporation Limited.
Mr. C. B. Davis	Abitibi Power and Paper Company Ltd.
(Substitutes: Mr. W. E. Willson and Mr. J. B. Mathews)	Abitibi Power and Paper Company Ltd.
Mr. W. A. Delahey	Abitibi Power and Paper Company Ltd.
Mr. W. A. Delahey	Great Lakes Paper Co.
Dr. G. H. Duff	Botany, University of Toronto.
Mr. T. L. Dunbar	Consultant.
Prof. R. O. Earl	Biology, Queen's University.
Mr. D. A. Gillies	Gillies Bros. & Co. Ltd.
Mr. J. H. Godden	Great Lakes Paper Company.
Dr. O. Holden	The Hydro-Electric Power Commission of Ontario.
Prof. R. C. Hosie	Forestry, University of Toronto.
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests.
Maj.-Gen. H. Kennedy	Consulting Engineer.
Mr. A. Koroleff	Pulp and Paper Research Institute of Canada.
Mr. W. J. LeClair	Canadian Lumbermen's Association.
Mr. G. A. Ledingham	National Research Council Regional Laboratory, Saskatoon.
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests.
Mr. D. A. Macdonald	Dominion Forest Service.
Mr. F. A. MacDougall	Ontario Dept. of Lands and Forests.
Dr. H. B. Marshall	Ontario Research Foundation.
Mr. T. A. McElhanney	Forest Products Laboratories, Ottawa.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto.
Mr. C. R. Mills	Ontario Forest Industries Association.
Dr. M. L. Prebble	Forest Insect Laboratory, Sault Ste. Marie.
Mr. A. H. Richardson	Ontario Dept. of Planning and Development.
(Substitute: Mr. A. S. L. Barnes)	Ontario Dept. of Planning and Development.
Mr. K. O. Roos	Booth Lumber Limited.
Mr. S. J. Staniforth	Staniforth Lumber Co. Ltd.
Mr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited.
Prof. J. O. Wilhelm	Ontario Research Commission.

## Meetings:

February 20th, 1946.....	Ontario Research Foundation, Toronto.
September 26th, 1946.....	Parliament Buildings, Toronto.
November 25th, 1946.....	Parliament Buildings, Toronto.
March 6th, 1947.....	Chateau Laurier, Ottawa.
September 29th, 1947.....	Forest Insect Laboratory, Sault Ste. Marie.
November 26th, 1947.....	Parliament Buildings, Toronto.

## Sub-Committees:

### Waste Sulphite Liquor

Dr. H. B. Marshall (Chairman)...	Ontario Research Foundation.
Dr. G. A. Adams.....	National Research Council.
Dr. F. Bender.....	Forest Products Laboratories, Ottawa.
Dr. W. Boyd Campbell.....	Pulp and Paper Research Institute of Canada.
Dr. G. A. Ledingham.....	National Research Council Regional Laboratory, Saskatoon.
Prof. R. R. McLaughlin.....	Chemical Engineering, University of Toronto.
Dr. G. H. Tomlinson, II.....	Howard Smith Paper Mills Limited.
Dean J. W. B. Sisam (ex officio)...	Forestry, University of Toronto.
Prof. J. O. Wilhelm (ex officio)...	Ontario Research Commission.

### Sawmilling Practice

Dean J. W. B. Sisam (Chairman)...	Forestry, University of Toronto.
Mr. W. J. LeClair.....	Canadian Lumbermen's Association.
Mr. T. A. McElhanney.....	Forest Products Laboratories, Ottawa.
Mr. K. O. Roos.....	Booth Lumber Limited.
Prof. J. O. Wilhelm (ex officio)...	Ontario Research Commission.

### Waste Slabwood Utilization

Dean J. W. B. Sisam (Chairman)...	Forestry, University of Toronto.
Mr. W. J. LeClair.....	Canadian Lumbermen's Association.
Mr. T. A. McElhanney.....	Forest Products Laboratories, Ottawa.
Prof. J. O. Wilhelm (ex officio)...	Ontario Research Commission.

### Biological Forestry

Prof. C. E. Atwood.....	Zoology, University of Toronto.
Mr. A. B. Baird.....	Dominion Parasite Laboratory, Belleville.
Mr. G. G. Cosens.....	Kimberly-Clark Corporation of Canada, Limited.
Mr. W. A. Delahey.....	Great Lakes Paper Co.
Dr. G. H. Duff.....	Botany, University of Toronto.
Prof. R. O. Earl.....	Biology, Queen's University.
Prof. R. C. Hosie.....	Forestry, University of Toronto.
Mr. R. N. Johnston.....	Ontario Dept. of Lands and Forests.



Maj.-Gen. H. Kennedy	Consulting Engineer.
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests.
Mr. D. A. Macdonald	Dominion Forest Service.
Mr. C. R. Mills	Ontario Forest Industries Association.
Mr. K. O. Roos	Booth Lumber Limited.
Dean J. W. B. Sisam	Forestry, University of Toronto.
Mr. W. E. Willson	Abitibi Power and Paper Company Ltd.
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission.

The direct and indirect results of forest depletion are too well known to require enumeration here. Scattered throughout the Province are river valleys which are depressing reminders of those results. Depletion can be prevented only by positive policies of conservation—policies which are timeless in viewpoint and which are backed by sufficient capital for long-term investment and by sufficient authority to control effectively all those who seek to exploit the forests. The Provincial Government has the responsibility of instituting and maintaining such policies.

Since building activity is so sensitive to business conditions the lumbering industry is and always has been subject to wide fluctuations. This sensitivity is of considerable importance to conservation for it implies a rapid turnover in the firms participating in the industry. The very insecurity of the enterprise has encouraged ruthless exploitation in times of boom while in times of depression the disappearance of firms or the need for retrenchment has made for neglect. The present preponderance of interest in pulp and paper points to a happier situation. High fixed capital costs mean that participating firms have a considerable stake in sound management. As a result, public and private interests are more compatible. But private conservation measures cannot be completely adequate since conservation policies must be formulated in terms of whole drainage basins.

It should be unnecessary to review past and present government activities in forest protection and forest management. Much has been done and much is being done. But even more remains to be done. The task is no longer one of merely protecting the gifts of Nature. Her beneficence must be fortified by direct assistance, and piecemeal policies must be supplanted by overall management.

Such assistance implies the existence of adequate forest knowledge and the fullest possible use of that knowledge. But there are many gaps in the information required and many gaps in the application of what is already known. One major deficiency is the lack of an adequate forest inventory—an inventory which must include not only complete data regarding existing stands but information regarding the rates of growth and the rates of depletion. A prerequisite to intelligent management of our forest resources is a reliable inventory of our forest assets.

The gaps in existing forest knowledge can be filled only by research. And, to a lesser extent, research is required to facilitate the best application of the information presently available. In neither case can forestry research be completely divorced from that in related fields. It must be correlated to the work being done in Soils, Agriculture, and Fisheries and Wildlife. It should look to Aerial Photography, Physiography and Climatology for assistance and it must not ignore the effects of air and water pollution.

The task then is one calling for the co-ordination of many talents over a considerable period of time. With this in view the following recommendations are submitted as a guide for correlation of effort in the setting up of specific research programs:

## **1. The Problem of Co-ordination and Continuity in Personnel and Administration**

- (a) The establishment of a permanent central body to
  - 1. which representations may be made concerning researches in forestry and the related fields;
  - 2. assess and correlate the research projects of these groups;
  - 3. advise the Government as to the financial assistance required to implement the research program devised;
  - 4. encourage the distribution of all available information;
  - 5. assist in the provision of the personnel required.
- (b) The encouragement of undergraduate and graduate studies and related fields by
  - 1. the establishment of a system of scholarships and other aids of adequate value to retain the best research personnel available;
  - 2. the continuation by the Provincial Department of Lands and Forests of the policy of recruiting departmental personnel from among those having university training in Forestry and related fields;
  - 3. the continuation of the policy of summer employment in summer forest projects for graduate and undergraduate students;
  - 4. the extension of staff and facilities for graduate work in the Faculty of Forestry, University of Toronto.
- (c) The establishment as soon as possible of an ecological centre.

## **2. Research Program**

### **(a) Forest Ecology.**

The correlation, with a view to securing a comprehensive land-use classification, of all the data obtained by

- 1. completion of an adequate Provincial soils survey;
- 2. extension of the studies in Physiography and Climatology;
- 3. studies on the microbiology of forest soils.

### **(b) Forest Management.**

#### **1. Inventory:**

- (i) A comprehensive survey of existing forest resources;
- (ii) Investigation of the rates of growth under varying conditions of tree distribution and age of stands, both natural and controlled;

- (iii) Investigation of techniques of aerial photography and associated inventory methods.

## 2. Regeneration:

- (i) Investigation of regeneration in (a) burnt-over and cut-over areas (b) swamp areas;
- (ii) Studies of the silvicultural characteristics of the native tree species in order of commercial importance;
- (iii) Genetical studies of native and valuable exotic species with the object of improving silvicultural characteristics;
- (iv) Design of more efficient tree planting and general nursery machinery;
- (v) The development of artificial seeding techniques and equipment.

## 3. Applied Forestry:

- (i) Investigations of farm woodlot management;
- (ii) Establishment of management areas to investigate and demonstrate the value of various silvicultural practices;
- (iii) Logging studies on various forest types to determine the best methods of removing the forest crop in relation to the cost of (a) delivering wood to the mill and (b) restoring the forest crop.

## (c) Forest Protection:

### 1. Biological:

- (i) Investigation of losses from and long-term effects of insects, animals and disease;
- (ii) Methods of control of insects and disease;
- (iii) The effect of different cutting methods on (a) fire hazards, and (b) biology of the forest.

### 2. Fire:

- (i) The development and design of specialized equipment for forest fire detection and suppression;
- (ii) Investigation of accurate rating for fire hazards;
- (iii) Investigation of fire weather forecasting.

## (d) The Problem of Utilization.

### 1. Present Wastages:

- (i) Investigations of existing wood wastes to secure profitable uses for
  - (a) logging wastes;
  - (b) milling and manufacturing wastes.



(ii) Better utilization of materials, for example,

(a) more efficient manufacturing methods;

(b) complete fabrication of existing products;

(c) utilization of present non-commercial tree species;

(d) development of a wider range of valuable forest products.

(e) Forest Hygiene

(i) The study of air and water pollution and their effect on the forest and on the community.

## RECOMMENDED PROJECTS—FORESTRY RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
<b>QUEEN'S UNIVERSITY BIO-LOGICAL STATION</b>				
1. Forest Regeneration and Woodlot Management. (R. O. Earl).	Queen's University.	\$ 315.00	\$ 1,185.00	\$ 1,500.00
2. Biology of the Basswood Leaf Miner. (A. S. West).	Queen's University.		690.00	690.00
3. Insects as Vectors of Bacteria. (A.S. West).	Queen's University.		2,720.00	2,720.00
4. Forest Insect Investigations. (A. S. West).	Queen's University.		900.00	900.00
		\$315.00	\$5,495.00	\$5,810.00
<b>UNIVERSITY OF TORONTO</b>				
5. Sawmill practice research. (W. G. McIntosh).	Department of Lands and Forests, Ontario Forest Products Laboratory, Ottawa.		10,000.00	10,000.00
6. Forest Tree Mycorrhiza. (G. H. Duff).	Department of Lands and Forests, Ont.		900.00	900.00
7. Regeneration Studies.	Department of Lands and Forests, Ont.; Forest Products Laboratory, Ottawa.		10,000.00	10,000.00
			\$20,900.00	\$20,000.00
<b>ONTARIO RESEARCH FOUNDATION</b>				
8. Waste Sulphite Liquor Utilization (H. B. Marshall).	.....		\$ 1,200.00	\$ 1,200.00
9. Wood Chemistry.	.....	2,000.00	18,000.00	20,000.00
		\$2,000.00	\$19,200.00	\$21,200.00
Unclassified as Yet.	.....			2,090.00
				\$50,000.00

## APPENDIX VI.

### INDUSTRY

#### Committee:

Mr. E. T. Sterne (Chairman) . . . .	G. F. Sterne & Sons Limited (Industrial Chemicals).
Mr. Thomas E. Boyce . . . . .	Disher Steel Construction Co. Ltd.
(Substitute:	
Mr. Howard Chamberlain) . . .	Lowe Bros. Co. Ltd. (Paints).
Mr. T. A. Faust . . . . .	Yocum Faust Limited (Industrial Chemicals).
Mr. G. C. Bernard . . . . .	Canadian Manufacturers' Association Inc.
Mr. F. J. Lyle . . . . .	Ontario Dept. of Planning and Development.
Mr. Lorne S. Campbell . . . . .	Ontario Dept. of Planning and Development.
Dr. H. B. Speakman . . . . .	Ontario Research Foundation.
Mr. A. B. Ward . . . . .	Ontario Research Foundation.
Mr. D. F. MacRae . . . . .	Ontario Research Foundation.
Prof. J. O. Wilhelm . . . . .	Ontario Research Commission.

#### Meetings:

April 14th, 1947 . . . . .	Ontario Research Foundation, Toronto.
May 9th, 1947 . . . . .	Ontario Research Foundation, Toronto.
June 18th, 1947 . . . . .	Ontario Research Foundation, Toronto.
September 12th, 1947 . . . . .	Ontario Research Foundation, Toronto.
November 4th, 1947 . . . . .	Ontario Research Foundation, Toronto.
December 1st, 1947 . . . . .	Ontario Research Foundation, Toronto.

Following the publication of the Interim Report of the Commission a working committee was set up comprising two members of the Department of Planning and Development, two from the Ontario Research Foundation, two from the Ontario Division of the Canadian Manufacturing Association, the Manager of the Ontario Division of the Canadian Manufacturers' Association and a member of the Ontario Research Commission as Chairman.

The Committee has been studying the problem and reports the progress made up to the present.

In the submission presented by the Ontario Division of the Canadian Manufacturers' Association and published in the Interim Report the following three suggestions were made:

1. Creation of a program conducted by the Ontario Research Foundation and designed to bring the work and facilities of the Foundation to the attention of manufacturers in the Province, and in particular to the smaller manufacturers;
2. Further exploration by the Foundation of the possibilities of bringing groups of industries with common problems into a closer relationship with the Foundation for the purpose of solving these problems on a basis of mutual benefit;

3. The encouragement of organizations of scientific and productive personnel within broad groups of industries, particularly those maintaining research facilities of their own, for the interchange of ideas and information which would help all these industries in their work.

In the spring of 1947 at the request of the Ontario Research Commission the Government made available the necessary funds to initiate the program and arrangements for the additional space required are in process of completion.

Your Committee can report definite progress.

With regard to the first of the recommendations made by the Canadian Manufacturers' Association the Ontario Research Foundation has been able to secure a thoroughly competent chemical engineer to head up a department co-operating with the Department of Planning and Development and with individual manufacturers. This department is known as the Ontario Industrial Research Service. Already more than 260 firms have made inquiries and of these 165 have led to laboratory work in the four months the Service has been in operation. The services being rendered exceed expectations and are taxing existing personnel and facilities. The future of this division promises to be of great service to our industries, large and small.

The carrying out of the second recommendation of the Canadian Manufacturers' Association respecting group research has met with some delays, but with the co-operation of the Canadian Manufacturers' Association and its committees this work will soon be begun.

The third recommendation involves a long-term policy based, to a large extent, on the first two recommendations. The work involved will have to be done in close co-operation with the Canadian Manufacturers' Association. The body that may be set up to carry this out will be responsible for directing this activity and maintaining interest in it.

A fourth recommendation designed to promote the training and wide distribution of trained technical personnel throughout industry, should have the leadership of the continuing organization that will work with the Canadian Manufacturers' Association, the Technical Service Council and other interested groups.

This Committee recommends that a permanent continuing committee of the Council be instituted, that its membership be based upon the same principle of representation as that upon which the present committee is based and that at least one member of the Council sit with the Committee at its sessions.

## RECOMMENDED PROJECTS—INDUSTRIAL RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
<b>ONTARIO RESEARCH FOUNDATION</b>				
1. Ontario Industrial Research Service.	Ontario Industries.	\$	\$ 38,500.00	\$ 38,500.00
2. Group Research.	Ontario Industries.		25,000.00	25,000.00
			63,500.00	63,500.00



## APPENDIX VII.

### INDUSTRIAL WASTE

#### Committee:

Mr. E. T. Sterne (Chairman)	G. F. Sterne & Sons Limited (Industrial Chemicals).
Dr. A. E. Berry	Ontario Dept. of Health.
Mr. G. A. H. Burn	Ontario Dept. of Health.
Prof. A. C. Plewes	Chemical Engineering, Queen's University.
Dr. H. B. Speakman	Ontario Research Foundation.
Mr. A. V. DeLaporte	Ontario Dept. of Health.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto.
Prof. J. O. Wilhelm	Ontario Research Commission.

#### Meetings:

June 18th, 1947	Ontario Research Foundation, Toronto.
July 17th, 1947	Ontario Research Foundation, Toronto.
September 12th, 1947	Ontario Research Foundation, Toronto.
November 4th, 1947	Ontario Research Foundation, Toronto.
December 4th, 1947	Ontario Research Foundation, Toronto.

At the request of the Ontario Research Commission a Committee was set up to study the overall problem of industrial wastes, and to recommend procedures to solve the problems bearing upon the eventual use or disposal of these wastes.

As Ontario becomes more densely populated, as the forests are cut down and the rivers and ground waters decrease in volume, industrial wastes increase and the problem of their disposal is progressively enlarged and each day becomes more urgent.

The Department of Health has submitted the following information and comment:

The industries in Ontario in which problems arising from the disposal of waste are the cause of great public concern include the following:

1. The milk industry, including all types of processing plants;
2. The canning industry;
3. Other food industries, including meat packing plants, food drying plants, processing plants, soft drinks, etc.;
4. Leather tanning;
5. Pulp and paper plants;
6. Oil wells and refineries;
7. Rubber manufacturing;
8. Woollen and textile plants;

9. Plants for producing many kinds of industrial chemicals, for example 2-4-D;
10. Manufacture of plastics;
11. Breweries and distilleries;
12. Metal working;
13. Gas and coke manufacturing;
14. Laundries.

NOTE: These industries are widespread in Ontario and they are increasing in number and in variety and quantity of products. Many of these industries discharge their wastes into public sewers and thereby create problems for municipalities. Other wastes are discharged direct into natural bodies of water such as lakes and rivers. New processes are continually being developed and these involve changing types of wastes.

The problem of waste disposal involves environmental sanitation and economics. The best results can be obtained only when research is conducted continuously and effectively.

As the milk industry is widely distributed all over the Province and is mainly in small plants with poor or no disposal facilities, your Committee has asked the Department of Health to estimate the financial requirement for launching work upon this disposal problem. This estimate is being submitted.

It is very plain from a study of the list of industries above that the problem of milk waste involves only the first of a long series of researches which must be undertaken in the whole field of waste disposal. The health of our people and the productivity of our industries are so dependent on finding solutions to the several problems of disposing of wastes that this work should be carried on with persistence and with courage.

The Experimental Station of the Ontario Department of Health in which much of this work might be carried on was constructed at Toronto in 1907. The main part of the building is in very poor condition. There is an obvious need for more adequate facilities for this type of work and it is strongly recommended that such facilities be provided.

Your Committee recommends that as the program progresses a similar continuing Committee with additional industrial representation be set up to further this work.

## RECOMMENDED PROJECTS—INDUSTRIAL WASTE COMMITTEE 1948-49

Title	Agency	Capital	Operating	Total
Milk Waste Disposal and Utilization.	Department of Health, Ontario.	\$	\$ 15,000.00	\$ 15,000.

## APPENDIX VIII.

### HIGHWAYS

#### Committee:

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association.
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways.
Mr. T. N. Carter	Ontario Road Builders' Association.
Mr. L. J. Chapman	Ontario Research Foundation.
Mr. D. J. Emrey	County Engineer, Kitchener.
Mr. T. F. Francis	Ontario Dept. of Highways.
Mr. W. B. Hastings	Ontario Motor League.
Mr. A. K. Hay	Federal District Commission.
Prof. R. A. Low	Civil Engineering, Queen's University.
Mr. J. A. P. Marshall	Ontario Dept. of Highways.
Dr. N. W. McLeod	Imperial Oil Limited.
Mr. W. J. Moore	Ontario Good Roads Association.
Mr. C. A. Robbins	Ontario Dept. of Highways.
Mr. D. O. Robinson	Canada Cement Company.
Prof. W. L. Sagar	Civil Engineering, University of Toronto.
Mr. J. Walter	Ontario Dept. of Highways.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario.
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission.

#### Meetings:

June 10th, 1947	Parliament Buildings, Toronto.
September 25th, 1947	Parliament Buildings, Toronto.
November 28th, 1947	Parliament Buildings, Toronto.
January 16th, 1948	Parliament Buildings, Toronto.

#### Sub-Committees:

##### Organisation

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association.
Mr. D. J. Emrey	County Engineer, Kitchener.
Mr. T. F. Francis	Ontario Dept. of Highways.
Mr. H. N. Lamont	Ontario Dept. of Highways.
Prof. R. A. Low	Civil Engineering, Queen's University.
Dr. N. W. McLeod	Imperial Oil Limited.
Mr. J. Walter	Ontario Dept. of Highways.
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission.

#### Planning, Economics and Administration

Prof. R. A. Low (Chairman)	Civil Engineering, Queen's University.
Mr. A. E. K. Bunnell	Ontario Dept. of Planning and Develop- ment.
Mr. W. A. Clarke	Division Engineer.
Mr. G. R. Marston	County Engineer.
Mr. W. J. Fulton	Ontario Dept. of Highways.
Mr. J. M. MacInnes	Ontario Dept. of Highways.
Mr. J. L. Zoller	Ontario Dept. of Highways.



## Soils and Foundations

Mr. J. Walter (Chairman).....	Ontario Dept. of Highways.
Mr. D. J. Emrey.....	County Engineer.
Prof. R. A. Low.....	Civil Engineering, Queen's University.
Mr. D. McGinnis.....	Contractor, Kingston.
Dr. N. W. McLeod.....	Imperial Oil Limited.
Mr. D. G. Watt.....	The Hydro-Electric Power Commission of Ontario.

## Design

Mr. D. J. Emrey (Chairman)...	County Engineer.
Mr. T. F. Francis.....	Ontario Dept. of Highways.
Mr. R. M. Lee.....	County Engineer.
Dr. N. W. McLeod.....	Imperial Oil Limited.
Mr. D. G. Ramsay.....	Ontario Dept. of Highways.
Mr. D. O. Robinson.....	Canada Cement Company.
Mr. J. Walter.....	Ontario Dept. of Highways.

## Materials and Construction

Mr. T. F. Francis (Chairman)...	Ontario Dept. of Highways.
Mr. C. Fraser.....	Ontario Dept. of Highways.
Mr. T. Johnston.....	Ontario Dept. of Highways.
Mr. E. W. Jones.....	County Engineer.
Mr. T. R. Patterson.....	County Engineer.
Prof. W. L. Sagar.....	Civil Engineering, University of Toronto

The results of the deliberations of this Committee are embodied in two resolutions:

1. That the Department of Highways be approached with a view to ascertaining whether or not, and to what extent, the Department would consider participating in a joint library scheme.

It was felt that present Highway Library facilities could be utilized to much better advantage than in establishing a new and independent library. This proposal is designed to provide adequate facilities and be of mutual benefit to the Department and the Highway Research body.

The following features are considered to be necessary in order to render an efficient service:

1. A trained librarian and adequate staff
  - (a) organize and index the existing facilities according to some definite system, e.g. the Legislative Library, Highway Research Board National Library;
  - (b) draw upon other sources for technical information and index the data so obtained;
  - (c) make this information available to all interested parties.
2. Extension of the present Department of Highways Library to provide adequate space for all requirements, including study and reading purposes. In allotting such space, ample provision should be made

not only for present requirements, but also for future expansion so that the original set up need not be unduly disturbed;

3. Provide an extension service to highway, county, township and municipal engineers and other interested parties, who would thereby have available information on the latest investigations in current highway practices.

Such a library might be established as one unit of a general co-operative library scheme designed to provide a comprehensive scientific library service for Government departments and other scientific groups in and about the Toronto area.

2. That a highways research program be now undertaken.

The following were selected as the subjects wherein further research is deemed to be most urgently needed, viz.:

1. Supporting Value of Subgrade Soils and Base Courses;
2. Soil Compaction and Frost Action of Subgrade Soils;
3. Durability of Bituminous and Concrete Aggregates;
4. Inventory of Granular Materials;
5. Design of Concrete and Bituminous Pavements.

The selection of these subjects was approved by the General Committee after careful consideration by its four sub-committees. As a helpful guide to them in making this selection they had available the answers to a questionnaire sent out by the Committee to 117 engineers, including every city, county and district engineer. This questionnaire listed fifteen highways research subjects and the recipient was asked to indicate which of these he considered most important and also the order of their importance, and to add to the list any subject which he thought should be included.

Answers to the questionnaire were received from 48 engineers. These answers were then classified. The five subjects above named were selected as deserving priority of attention in the proposed Highways Research program. Each of these subjects was then assigned to the particular sub-committee or sub-committees to which it appeared to belong. This procedure enabled the Committee to consider what steps should be taken to carry out the research required.

Of the several agencies which might be expected to participate in the carrying out of such a research program the Committee recognizes that the Department occupies a position of paramount importance, and that it is already engaged in a limited program of highway research.

The Committee's recommendations if adopted by the Department would involve, therefore, simply an expansion and possible intensification of the present program. Such an expansion would probably require the employment of additional trained personnel for full time research work, the purchase from time to time of additional research equipment, and an increased annual expenditure on account thereof.

The Committee's estimate of the amount which would be required each year to finance the carrying out of such a program of research is \$250,000. In a year when the total provincial expenditure on highways was \$50,000,000

or over, the spending of \$250,000 for highways research would represent not over  $\frac{1}{2}$  of 1% (one-half of one per cent) of the total. That this is a comparatively modest percentage is evident from a comparison with the percentage expended for research in other cases, e.g. 8/10 of 1% in Great Britain, 1% in U.S.A., 1% in Russia and 1% in Canada at the Dominion level. Furthermore, if the amount estimated as being required to cover the cost of such a program seems high, the possible cost to the Province of failing to pursue such a program must not be lost sight of.



## APPENDIX IX.

### AERIAL SURVEY

#### Committee:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited.
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Mr. J. A. Brodie	Ontario Dept. of Lands and Forests
Mr. L. J. Chapman	Ontario Research Foundation
Dr. W. Clark	Eastman Kodak Company
Dr. D. R. Derry	Ventures, Limited.
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. G. Godwin	The Ontario Paper Company, Limited
Dr. L. E. Howlett	Optics Section, National Research Council
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Company, Limited
Mr. Tom C. McCall	Ontario Dept. of Travel and Publicity
Mr. C. R. Mills	Ontario Forest Industries Association
Prof. F. F. Morwick	Ontario Agricultural College
Prof. J. E. Reid	Electrical Engineering, University of Toronto
Mr. A. H. Richardson	Ontario Dept. of Planning and Development
Mr. J. R. G. Smyth	Ontario Dept. of Lands and Forests
Prof. W. M. Treadgold	Civil Engineering, University of Toronto
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission

#### Meetings:

April 22nd, 1947	Parliament Buildings, Toronto
January 5th, 1948	Engineering Building, University of Toronto

#### Sub-Committees:

##### Photography

Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Company, Limited

##### Photogrammetry

Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. K. H. Siddall	Ontario Dept. of Highways
Prof. W. M. Treadgold	Civil Engineering, University of Toronto
Mr. J. G. Wilkenson	Photographic Survey Company, Limited

An informal conference on Aerial Survey was held on March 13th, 1947. As a result, a submission was made to the Ontario Research Commission on

April 8th recommending the establishment of an Advisory Committee on Aerial Survey, the Committee to include representatives of:

1. Government agencies which produce or use aerial photographs;
2. University departments concerned with the individual problems of aerial photography and the application of aerial photographs in their respective subject areas;
3. Photographic surveying companies;
4. Manufacturers of photographic materials, and of photo-survey equipment.

The general problem which was placed before the Committee involved:

**1. Photography:**

- (a) Choice of photographic materials and processes to suit general or specific needs;
- (b) Choice or design of suitable camera equipment;
- (c) Application of navigational aids, camera stabilizers and automatic pilots;
- (d) Determination of scale requirements for specific purposes.

**2. Photogrammetry:**

- (a) Analysis of the dimensional stability of negative and positive materials;
- (b) Analysis of present methods of Planimetric plotting and of transferring detail from photographs to base maps;
- (c) Determination of cost and available accuracy in topographic mapping by approximate and rigorous methods;
- (d) Development of new methods and equipment to most specific needs.

At its first meeting on April 22nd the Committee considered the program and divided the work among several sub-committees. These sub-committee worked out a series of projects to be conducted during the summer season of 1947. The preliminary reports on these projects are in the hands of the sub-committees and are being prepared for submission to the Main Committee

## AERIAL SURVEY RESEARCH—1948-49

Title	Participating Agencies	Budget
1. The Extension of the Work on Photographic Interpretation by J. R. G. Smyth and G. W. Rooney including: Variations in Scale, Filters, and Types of Terrain for Use in Forestry, Geology and Agriculture. (K. B. Jackson).	Photographic Survey Company; Dept. of Lands and Forests; Applied Physics, University of Toronto; Dept. of Mines; Eastman Kodak Company; The National Research Council.	\$
2. An Investigation of the Relative Merits and Costs of Transparencies and Paper Prints for Detailed Interpretation of the Photographs. (K. B. Jackson).		
3. An Investigation of the Dimensional Stability of Positive Printing Materials when used for Mapping. (K. B. Jackson).		
4. A Survey of Present Practices in Sensitometric Control and Preparation of Recommendations for Standard Specifications. (K. B. Jackson).		\$5,000.00

## APPENDIX X.

### SCHOLARSHIPS

Since the development and extension of research and, in consequence, of industrial progress in Ontario, is vitally dependent upon the availability of trained personnel, the Ontario Research Commission recognizes that the Province, the universities, the technical institutions, and the industries of the Province, individually and collectively, have significant roles to play in the training of persons who can give useful assistance in the research field.

The Commission is of the opinion that an important contribution to the carrying on of fundamental and applied research may be made by furthering the training of technicians in courses of the technical institute type extending over a period of one or two years at a level lying between that of the vocational high schools and that of the universities. The assistance of an adequate number of such persons would approximately double the effectiveness of the all too few fully qualified university graduate research workers.

The Commission desires to commend in general the longer and more advanced programs of educational training in industry as productive of persons valuable to research. It is to be hoped that industry may be able to extend this service.

The Commission realized that the need for trained personnel could not be met completely by the provision of scholarships. Nevertheless, to assist students with ability and as an adjunct to a complete program the provision of financial assistance to outstanding students plays a useful part.

As a result, during 1946-47 the Ontario Research Commission requested that \$20,000 be made available to provide scholarships for research students. Through recommendations from the Advisory Committees, ten scholarships were granted for work to be done during the 1946-47 term.

During the present year the Government provided a sum of \$50,000 for scholarships and \$44,275 has been spent in supporting 58 scholarships. 27 have been granted of a value of \$500, 25 of a value of \$900, and 6 of a value of \$1,200, and \$1,075 has been granted to provide travelling expenses.

The distribution among subjects is as follows:

Physics .....	22
Chemistry .....	8
Metallurgy .....	5
Forest Entomology .....	5
Limnology .....	4
Biology .....	3
Zoology .....	3
Physiology .....	3
Other subjects .....	5



The students are working in these universities:

University of Toronto . . . . .	35
Queen's University . . . . .	7
McMaster University . . . . .	5
University of Western Ontario . . . . .	4
Ontario Agricultural College . . . . .	2
Yale University . . . . .	1
Ohio State University . . . . .	1
University of Michigan . . . . .	1
University of Cambridge . . . . .	1
University of Amsterdam . . . . .	1

As a continuing policy it would seem to be desirable that there be some annual amount appropriated each year to provide scholarships. The amount might be a definite proportion of the annual research budget, say 10%.

## APPENDIX XI.

### PROVINCIAL RESEARCH EXPENDITURES

Research expenditures within the Province for the year 1947 are given below.

#### CAPITAL EXPENDITURES—ESTIMATED 1947

Department	Branch	Research	Develop- ment	Analysis and Testing
Agriculture	Ontario Veterinary College	7,800.00	10,300.00	4,000.00
Agriculture	Horticultural Experiment Station	125,000.00	—	—
Agriculture	Ontario Agricultural College	15,500.00	4,700.00	2,050.00
Agriculture	Experimental Farm, Ridgeway	—	—	—
Land and Forests	Fish and Wildlife	3,500.00	50,000.00	3,500.00
Land and Forests	Forestry	3,700.00	15,000.00	3,000.00
Mineral Resources	Geology	—	—	—
Highways	Soils and Research	2,000.00	3,000.00	10,000.00
Health	Public Health	—	2,100.00	—
		\$157,500.00	\$85,100.00	\$22,550.00

#### OPERATING EXPENDITURES—ESTIMATED 1947

Department	Branch	Research	Develop- ment	Analysis and Testing
Agriculture	Ontario Veterinary College	26,200.00	52,600.00	13,000.00
Agriculture	Horticultural Experiment Station	86,000.00	15,000.00	—
Agriculture	Ontario Agricultural College	198,732.00	34,204.00	105,221.00
Agriculture	Experimental Farm, Ridgeway	500.00	3,500.00	—
Land and Forests	Fish and Wildlife	75,300.00	—	14,200.00
Land and Forests	Forestry	69,200.00	48,500.00	12,300.00
Mineral Resources	Geology	9,500.00	288,000.00	—
Highways	Soils and Research	15,000.00	18,000.00	138,400.00
Health	Public Health	43,544.00	20,326.00	800,590.00
		\$523,976.00	\$480,130.00	\$1,083,711.00

Ontario Research Commission:	Research Grants	\$300,000.00
	Scholarships	50,000.00
	Administration	22,000.00

#### SUMMARY—RESEARCH EXPENDITURES—1947

Departmental	\$523,976.00
Ontario Research Commission	372,000.00





## APPENDIX XII.

### DEFINITIONS OF RESEARCH AND SCIENTIFIC ACTIVITY<sup>1</sup>

Three major types of research work can be distinguished: (a) pure or fundamental research; (b) background research, and (c) applied or practical research.

**Pure or Fundamental Research** is defined as an investigation directed towards a discovery of previously unknown facts resulting in general knowledge and understanding of nature and its laws. The material application of the results of pure or fundamental research are not, of necessity, a basic consideration in undertaking this type of research but it forms the fundamental basis for all applied research and development work.

**Background Research** is defined as the collection and analysis of initial data for both pure and applied research. It consists of surveys and descriptions of basic facts such as the preparation of accurate geological maps, the determination of physical and chemical constants, the description of species of animals, plants, and minerals, the determination of standards such as those established for hormones, drugs, etc.

**Applied or Practical Research** is defined as an organized effort directed towards new applications of known scientific facts or principles to practical problems. As indicated previously, the distinction between fundamental and applied research is not always a hard and fast one and both contribute to progress in scientific knowledge. To give an instance, the study of the principles of electronics would be classed as pure research while the investigation of ways and means to use electronics in the home or factory would be applied research.

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<sup>1</sup>Research and Scientific Activity, Canadian Federal Expenditures—1938-1946. Pages 11 and 12.

# APPENDIX XIII.

## SUMMARY OF RECOMMENDED BUDGET EXPENDITURES—1948-49

	Capital	Operating	Total	
	\$	\$	\$	
<b>FISHERIES AND WILDLIFE COMMITTEE</b>				
McMaster University.....	5,037.00	20,165.00	25,202.00	
Queen's University.....	1,850.00	5,466.00	7,316.00	
University of Western Ontario.....	5,950.00	11,050.00	17,000.00	
University of Toronto.....	2,900.00	17,750.00	20,650.00	
Royal Ontario Museum of Zoology.....	1,500.00	14,850.00	16,350.00	
Ontario Research Foundation.....	2,775.00	24,200.00	26,975.00	113,493.00
<b>FORESTRY COMMITTEE</b>				
Queen's University.....	315.00	5,495.00	5,810.00	
University of Toronto.....	—	20,900.00	20,900.00	
Ontario Research Foundation.....	2,000.00	19,200.00	21,200.00	
Unclassified as yet.....	—	—	2,090.00	50,000.00
<b>MINES, MINERALS AND METALLURGY COMMITTEE</b>				
University of Toronto.....	6,020.00	10,047.00	16,067.00	
Queen's University.....	15,000.00	5,000.00	20,000.00	
Ontario Research Foundation.....	10,000.00	39,550.00	49,550.00	
McMaster University.....	—	—	5,000.00	90,617.00
<b>INDUSTRIAL RESEARCH COMMITTEE</b>				
Ontario Industrial Research Service.....	—	38,500.00	38,500.00	
Group Research.....	—	25,000.00	25,000.00	63,500.00
<b>INDUSTRIAL WASTE COMMITTEE</b>				
Department of Health.....	—	15,000.00	15,000.00	15,000.00
<b>AGRICULTURAL COMMITTEE</b>				
Ontario Research Foundation.....	2,000.00	18,000.00	20,000.00	20,000.00
<b>SOILS COMMITTEE</b>				
Ontario Research Foundation.....	1,300.00	22,425.00	23,725.00	23,725.00
<b>AERIAL SURVEY COMMITTEE</b>				
University of Toronto.....	—	—	5,000.00	5,000.00
<b>SCHOLARSHIPS.....</b>			50,000.00	50,000.00
<b>ADMINISTRATIVE UNIT.....</b>			25,000.00	25,000.00
				\$456,335.00







# RESEARCH COUNCIL OF ONTARIO

## *Annual Report*

1948 - 1949



TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY





DEPARTMENT OF PLANNING & DEVELOPMENT

August 30th, 1949.

TO THE HONOURABLE RAY LAWSON, O.B.E.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour the Annual Report of the Research Council of Ontario for the year ended March 31st, 1949.

Respectfully submitted,

WILLIAM GRIESINGER,  
Minister.

RESEARCH COUNCIL OF ONTARIO  
39 Queen's Park Cres., Toronto 5,  
August 30th, 1949.

THE HONOURABLE WILLIAM GRIESINGER,  
Minister of Planning & Development.

SIR:

I have the honour to submit to you the Annual Report of the Research Council of Ontario for the year ended March 31st, 1949, in accordance with the requirements of the Research Council Act.

Respectfully submitted,

ROBT. C. WALLACE,  
President.

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## RESEARCH COUNCIL OF ONTARIO

		Term
Dr. R. C. Wallace (President) ....	Principal, Queen's University, Kingston	1953
Dr. R. K. Stratford ..... (Vice-President)	Research Director, Imperial Oil Limited, Sarnia	1952
Dr. C. E. Burke ..... (Died, May 15, 1949)	Dean of Arts and Science, McMaster University, Hamilton	1951
Dr. E. Holt Gurney .....	President, Gurney Foundry Company, Toronto	1953
Dr. G. E. Hall .....	President, University of Western Ontario, London	1951
Col. W. E. Phillips .....	1200 Bay Street, Toronto	1953
Prof. G. N. Ruhnke .....	Director of Research, Ontario Dept. of Agriculture, Ontario Agricul- tural College, Guelph	1953
Dr. Sidney E. Smith .....	President, University of Toronto, Toronto	1952
Mr. E. T. Sterne ..... (Died, Feb. 2, 1949)	Manager, G. F. Sterne & Sons Limited, Brantford	1951
Mr. H. M. Turner .....	President, Canadian General Electric Company Limited, Toronto	1952
Dr. C. R. Young .....	Dean, Faculty of Applied Science and Engineering, Toronto	1951

### Director

J. O. Wilhelm .....	Research Council of Ontario, Toronto
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### Meetings:

May 5th, 1948, 39 Queen's Park, Toronto.  
 October 10-11th, 1948, General Brock Hotel, Niagara Falls.  
 November 25th, 1948, 39 Queen's Park, Toronto.  
 December 14th, 1948, 39 Queen's Park, Toronto.

### Executive

Dr. R. C. Wallace (President) ....	Principal, Queen's University, Kingston.
Dr. R. K. Stratford ..... (Vice-President)	Research Director, Imperial Oil Limited, Sarnia.
Dr. E. Holt Gurney .....	President, Gurney Foundry Company, Toronto
Dr. G. E. Hall .....	President, University of Western Ontario, London.
Dr. C. R. Young .....	Dean, Faculty of Applied Science and Engineering, Toronto.

## Meetings:

- June 10th, 1948, 39 Queen's Park, Toronto.  
September 23rd, 1948, 39 Queen's Park, Toronto.  
January 19th, 1949, 39 Queen's Park, Toronto.  
February 25th, 1949, 39 Queen's Park, Toronto.  
March 14th, 1949, Council Chambers, Parliament Buildings, Toronto.

## Scholarship Committee

Dr. R. C. Wallace (Chairman) .....	Principal, Queen's University, Kingston.
Dr. E. Holt Gurney .....	President, Gurney Foundry Company, Toronto.
Dr. G. E. Hall .....	President, University of Western Ontario, London.
Dr. C. E. Burke .....	Dean of Arts and Science, McMaster (Died, May 15, 1949) University, Hamilton.
Prof. G. N. Ruhnke .....	Director of Research, Ontario Department of Agriculture, Ontario Agricultural College, Guelph.
Dr. Sidney E. Smith .....	President, University of Toronto, Toronto.
Dr. C. R. Young .....	Dean, Faculty of Applied Science and Engineering, Toronto.

## Meeting:

- February 25th, 1949, 39 Queen's Park, Toronto.

## Foreword

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This report of the operations of the Research Council of Ontario for the year 1948-49 is in essence a statement by the Director and a summary of the work of the advisory committees as submitted by the respective chairmen. When the report is studied, it will be noted that the significant thing that the Council is doing is in providing the means of co-operation to scientists and industrialists to work out the most satisfactory plan of research, whether under Federal, Provincial, university, Research Foundation or private auspices, for the benefit of our Province and its industrial prosperity. In this the Council has achieved marked success. It can be stated with assurance that the whole field is under constant survey, that all overlapping is safeguarded against, and the industrialists are becoming more and more alert to the service which research can perform for them. In order to further this general conception of the function of the Council, the scholarships which are being awarded to able graduates to pursue their training in research are a guarantee that competent and well equipped workers will be available in the years to come to fill the positions in industrial research for which the demands will grow rapidly with the years.

The members of the Council would desire to express their appreciation of the untiring energy of the Director and the very valuable assistance that has been given by the chairmen and members of the advisory committees.

ROBT. C. WALLACE,  
President



## DIRECTOR'S REPORT

### General Administrative Office

During the year the Director has attended many formal and informal meetings as representative of the Council. He has addressed many groups, professional societies and service clubs and has taken part in scientific and technical meetings. Some of the meetings, visits and lectures are listed here:

#### Meetings:

- May 27, 28 and 29, 1948      Attended meeting Canadian Association of Physicists, Ottawa.
- June 14-19, 1948      Royal Society of Canada, Vancouver.  
Informal Conference on Administration of Research, University of British Columbia.
- December 6-11, 1948      Albany, N.Y., and Washington, D.C.—Meetings with various government departments on administrative proceedings—Highway Research Board meetings, etc. (with Mr. Harold Chater).

#### Visits:

- June 14-19, 1948      British Columbia Research Council Laboratories.  
British Columbia Research Council Annual Meeting.  
Fisheries Research Board Laboratories, Vancouver.  
University of British Columbia, Departments of Physics and Zoology.  
Forest Products Laboratory, Vancouver Branch.  
H. R. MacMillan Company Mill at Westminster.
- June 21, 1948      Alberta Research Council and University of Alberta, Departments of Chemistry, Physics and Engineering.
- June 22, 1948      Prairie Regional Laboratory, National Research Council, Saskatoon.  
University of Saskatchewan, Departments of Physics, Chemistry and Engineering.
- June 25, 1948      University of Manitoba, Science Departments.
- July 25, 1948      Trout Lake Salmon Experiment, North Bay.
- July 27, 1948      Forest Insect Laboratory, Sault Ste. Marie.
- July 28, 1948      Kirkwood Management Unit, Thessalon.
- July 29-30, 1948      South Bay Experiment, Manitoulin Island.
- July 31, 1948      Clarksburg Experiment, Meaford, Ont.
- August 1, 1948      Wildlife Laboratory, Algonquin Park.

#### Lectures:

- January 9, 1949      "Research in Canada"—Young People's Society, Mimico.
- March 4, 1949      "Research in War and Peace"—Humberside Collegiate.
- March 9, 1949      "Research"—Canadian Society Forest Engineers. Toronto Branch.

In addition, the Director attended all of the meetings of the Council and the advisory committees and most of the meetings of the sub-committees.

The Director has maintained contact with the professional groups through meetings of the various associations. The Canadian Pulp and Paper Association, Canadian Manufacturers' Association, Canadian Society of Forest Engineers, Canadian Association of Physicists, Royal Society of Canada, etc. He has served as Chairman of the Canadian Standards Association Committee on Mechanical Refrigeration and as a member of various scientific committees in both an official and private capacity.

The work of preparing for the meetings of the Council, of the advisory committees, and of the sub-committees has proceeded smoothly due to the excellent co-operation which has been received from all concerned with the arrangements. The regular meetings of the committees and the Council are recorded elsewhere. The facilities provided by the new offices at 39 Queen's Park have been of special assistance in conducting the many committee meetings.

The scholarship plan of the Council was brought to the attention of students in the Ontario universities by announcements and by visits of the Director to the universities in Ontario. The lists were prepared and awards were made on the basis of policies laid down by the Scholarship Committee.

During the year the Council met regularly. Members of Council also attended some of the advisory committee meetings and represented the Council at conferences and other gatherings.

The office staff during the year has consisted of the Director and two secretaries with temporary assistance from typists and stenographers as was required. During the summer of 1948 Mr. G. R. Elliott and Mr. Norman Morse, students working toward their doctorate in the Political Economy Department of the University of Toronto, were employed to make preliminary economic surveys in several fields where research was being conducted. The purpose of this was two-fold: (1) to obtain information; (2) to stimulate an interest in the economics of research.

## Scholarships

Any comprehensive research program planned for the Province must, of necessity, raise the problem of available personnel and the problem of the provision of the necessary facilities and personnel to educate an adequate body of properly trained workers. On the basis of the preliminary recommendations of the Ontario Research Commission<sup>1</sup>, a system of scholarships was initiated in Ontario in 1946.

In the Final Report of the Commission<sup>2</sup>, the question of research personnel was emphasized again: "The supply of trained personnel is far below the number needed to carry on the program of research for which financial support is available even now. That the existence of a sufficiently large and highly trained staff is the prime prerequisite to carrying out successfully a worth-while program of research is patent to everybody. There are occasions when improvised physical facilities may serve satisfactorily but only when at the same time there is the trained staff to direct the improvising. But personnel can never be improvised, since there is no substitute whatever for the highest type of skill and training involved. It is of the utmost importance not only that the number of scientists be adequate but also that they be distributed among the several fields of research in proportion to the relative

<sup>1</sup>Interim Report, Ontario Research Commission, February, 1947, Sessional Paper No. 47, 1947.

<sup>2</sup>Final Report, Ontario Research Commission, January, 1948, Sessional Paper No. 42, 1948.

needs of these fields. It will be one of the duties of the Council to determine at the outset the nature and extent of all physical facilities required, and the numbers and composition of the personnel needed to carry out the programs of research outlined. This will enable the Province to maintain material and personnel at proper levels."

The scholarship program has been an active one and is closely co-ordinated with the other work of the Council. Scholarships have been awarded as follows:

1946-47—11 .....	\$10,000.00
1947-48—58 .....	44,275.00
1948-49—66 .....	47,420.00
1949-50—61 .....	50,000.00

It is too early yet to know what effect these scholarships will have on retaining trained personnel in Canada but it is obvious that more are required than can be recruited in a regular way and every effort should be made to retain our specialists. A canvass of 104 people who held scholarships up to January, 1949, showed the following distribution: 74 are still continuing their studies, 9 are employed in Canadian universities, 10 are employed in the Dominion Government, 4 are employed in the Provincial Government and 7 hold industrial positions in Canada. It will not always be possible, nor may it be desirable, that all our students remain in Canada.

The work is going forward in many fields in many universities<sup>1</sup>. The distribution by universities for the 1948-49 group of scholarships is as follows:

University of Toronto .....	39
Queen's University .....	8
University of Western Ontario .....	1
McMaster University .....	5
Ontario Agricultural College .....	2
McGill University .....	4
U.S. universities .....	5
British universities .....	2

The distribution among the sciences in 1948-49 was:

Physics .....	27
Biological Sciences .....	18
Agriculture .....	4
Geography .....	4
Geology .....	3
Metallurgy .....	3
Chemistry .....	3
Electrical Engineering .....	2
Mathematics .....	1
Astronomy .....	1

It takes time for a research worker to produce results that may be applied to practical problems. Several of the students have, however, made distinct contributions even in the short time that the scholarships have been available.

The natural field from which to select students is from the recent graduating classes of the Ontario universities. An effort is also being made to recruit the best students from other parts of Canada and the Commonwealth for Ontario problems. The majority are doing their research work in Ontario universities but

<sup>1</sup>See Appendix II for a detailed list of awards made during 1948-49.



a proportion take their training elsewhere in Canada and in other countries where special facilities and supervision are available to provide the specialized training they require<sup>1</sup>.

## Universities

Through recommendations of the advisory committees, various grants-in-aid have been made to the universities in the Province. These are generally made to an individual who by reason of (a) his interest and (b) the research team of which he forms a part, is particularly suited to carry out the investigation. During the 1948-49 fiscal year some \$111,940 was expended in research within the universities. Reports on the work are made regularly and a number of scientific publications have resulted from the researches.

## Ontario Research Foundation

The closest liaison is maintained with the work of the Ontario Research Foundation. This is achieved in several ways: (1) the Foundation staff is represented on and takes an active part in the work of the Council advisory committees; (2) several of the research projects being conducted by the Foundation receive general supervision and guidance from Council committees; (3) the Advisory Committee on Industrial Research takes an active interest in the Industrial Research Services division of the Foundation and in the group research plan which is under the direction of the Foundation; (4) the offices of the Council are in one of the Foundation buildings and there are daily contacts and almost daily conferences between the staffs of both the Council and the Foundation.

## Provincial Government Departments

The Provincial Government departments are represented on many of the advisory committees. In addition to this direct contact, there is a good deal of joint discussion between the Director of the Council and departmental officials in regard to research projects. Necessarily, the departments having research divisions have a good deal more to do with the Research Council and the Council committees; for example, the Division of Research, Department of Lands and Forests and the Trade and Industry Branch of the Department of Planning and Development.

## Dominion Government

Through direct representation on Council committees and through ad hoc conferences, the activities of the Research Council of Ontario are co-ordinated with the Dominion agencies. Cross representation on committees is maintained and in many cases committee minutes are distributed to others than committee members who have an interest along the line of the committee work.

Some of the Dominion agencies with whom the Council has co-operated are: (a) National Research Council; (b) Forest Products Laboratory; (c) Meteorological Service; (d) Bureau of Mines; (e) Science Service Division, Department of Agriculture; (f) Defence Research Board.

## Foreign Contacts

Direct contact has been made with many research groups in the United States, Britain and Europe. The members of advisory committees who have attended foreign meetings have brought first-hand reports of these meetings. The Liaison Offices of the National Research Council in Washington and in London have been helpful on numerous occasions in obtaining information and in arranging the itineraries of visitors from Canada.

<sup>1</sup>"Graduate Students Who's Who—Scholarships—1947-48"—Report 9-1-48.

## Committees and Their Work<sup>1</sup>

In order to secure the fullest possible amount of authoritative data upon research in various fields, the Council has continued the policy of the Ontario Research Commission and has continued a committee composed of persons who are best acquainted with each field. Since the committee includes, in addition to workers in scientific research, representatives of both federal and provincial departments charged with the administration of natural resources, as well as representatives of interested industries, the Council is sure that the representation thus provided is satisfactorily comprehensive. For the guidance of each committee its function has been clearly outlined by the Council.

- (a) to survey its specific field thoroughly;
- (b) to report to the Council such facts as it may find regarding the status of the research in that field, and, further, to report upon the existing facilities and trained personnel required;
- (c) to recommend the means for applying scientific knowledge.

By means of this division of duties among the several committees the Council attains two results of primary importance:

- (a) a manageable co-ordination of the great volume of diverse material submitted by the committees;
- (b) a clear conspectus of the real problem and of the active program required in the whole territory of research in Ontario.

The main advisory committees have held approximately 16 meetings, the sub-committees 12, and executive committees held 16 meetings. Most of the meetings were held in Toronto but some were held in other places in the Province which are of special interest to the particular committee concerned. This permitted discussion of local problems, since interested scientists in the area were invited to sit with the committees.

The research activities under the committees are too numerous to list or describe here but the review of the committees gives a general idea of the way in which the committee system functions.

## ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

Chairman: Prof. K. B. Jackson

The problem before this Committee is little changed from last year. Some progress has been made and work is going forward actively by government, university and industrial agencies.

The problem is a dual one: (1) in the field of photography, to improve photographic materials and processes to meet Provincial needs, to design suitable camera equipment and to apply the results of research to the various purposes for which such equipment is used; (2) in the field of photogrammetry to determine the physical limits of stability of material for negatives and positives, to examine the accuracy of the various methods of translating photo material to base map data and to examine new methods and equipment for meeting Provincial needs.

During the year the Committee discussed problems in the fields of Mining, Highways, Agriculture, Lands and Forests and Industry. Some research was done in the Faculty of Applied Science and Engineering at the University of Toronto under the supervision of Professor K. B. Jackson. This work is continuing and will be enlarged when funds for equipment are available.

<sup>1</sup>A complete list of members of Advisory Committees and Sub-Committees is shown as Appendix III.

## ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH

Chairman: Mr. C. F. Luckham

Research relating to agriculture in Ontario is in the main covered by the Provincial Department of Agriculture and the Ontario Agricultural College. The Advisory Committee on Agricultural Research has not been active during the year because of a survey that is in progress in the Department by Professor G. N. Ruhnke, Director of Research. For a comprehensive statement of the research in hand in agriculture, reference should be made to the reports of the Department of Agriculture, both Dominion and Provincial, and the various agricultural agencies within the Province.

The Dominion Department of Agriculture conducts research in the Province, mainly in connection with the Ontario Department of Agriculture and the Ontario Agricultural College, but also in connection with the Ontario Department of Lands and Forests and the universities in the Province.

## ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE RESEARCH

Chairman: Prof. J. R. Dymond

Secretary: Dr. A. M. Fallis

The importance of fisheries and wildlife research in Ontario is emphasized by the percentage of our area which will produce fish and wildlife and especially the extent of the area which will produce no other permanent crop.

The following estimate is rough but at least approximate:

Cleared agricultural land .....	10%
Forest land .....	40%
Muskeg, rock and inaccessible forest land .....	30%
Water, including the Canadian portion of the Great Lakes .....	20%

This means that at least 90% of the area of Ontario will produce fish and wildlife and 50% will produce no other permanent crop.

### Stimulation of Research

Since 1945 when the Ontario Research Commission was appointed, research in fisheries and wildlife in Ontario has increased five or six fold. It should be remembered, however, that during the war, research in these fields in Ontario had been somewhat curtailed as compared with the prewar period.

During 1948, the number of persons engaged in fisheries and wildlife research in Ontario was 128, made up as follows: permanent staff members of universities Government departments and research organizations 34, graduate students 28, undergraduates 54, others 12. Many of these spent only the summer months in research or in assisting senior research personnel.

This increase in research activity resulted chiefly from two actions by the Provincial Government, the appointment of the Research Commission and the amalgamation of the former Department of Game and Fisheries with the Department of Lands and Forests and the organization within the latter of Divisions of Fish and Wildlife and of Research with research-minded chiefs in charge.

Although the stimulation of research has come about largely through Provincial action and support, Federal research funds have been made available through the National Research Council grants-in-aid and scholarships. Private funds have also



contributed notably through Carling Conservation Club support of the Royal Ontario Museum of Zoology's research on moose and maskinonge.

### Variety of Research

A wide variety of problems presented by our fisheries and wildlife are being studied. There are studies on all types of waters including the Great Lakes, inland lakes, marshes and streams.

Great Lakes studies include work on Lakes Ontario, Erie and Huron and a start is soon to be made on Lake Superior. These studies include a long term study of the changes in the fish population of Lake Erie. This is to be correlated with the University of Western Ontario's study of the limnological studies in the same lake in an effort ultimately to understand the underlying causes for the changes which occur in the relative numbers of the different kinds of fish. Such an understanding may make it possible to influence the production of different kinds through fishing methods, although prediction of yields of the various species may be possible before control is effected. As a matter of fact the first season's work on the lake herrings had indicated that the present large population of these fish is not likely to continue beyond the lifetime of the present year-class, or until another large year-class appears. The President of the Ontario Federation of Commercial Fishermen has stated "the research on the lake herring of Lake Erie has already thrown sufficient light on the problems involved to assist materially the commercial fisherman in planning their fishing operation."

On Lakes Ontario and Huron tests are being made of the value of hatcheries in maintaining or increasing whitefish and lake trout. At South Bay, Manitoulin Island, a thorough test of the effect of commercial fishing on the fish population including the effect on game fish is being undertaken.

Inland lakes are being studied in Southern Ontario by Queen's University on the Rideau lakes and in the north by the University of Toronto in Algonquin Park. Northwestern Ontario is not being neglected. Studies on the lakes of Quetico and Sibley Provincial Parks have been made and work on the Lake-of-the-Woods was undertaken in 1947.

Marsh studies are centred at McMaster University. Shoal-water areas constitute an important part of the water areas of Ontario. Besides serving as homes for many forms of plant and animal life, some of these areas act as storage reservoirs at the headwaters of streams. As a basis for planning the wise use of such areas it is necessary to have knowledge of these water areas under Ontario conditions.

Streams are being studied both in the rocky areas of the north and in the agricultural south. In the latter area these studies are co-ordinated with the river valley surveys of the Department of Planning and Development. The possibility of restoring the salmon to some of the streams tributary to Lake Ontario has been under way for four years.

Species of fish to which special attention is being given include the parasitic sea lamprey, whitefish, lake herring, Atlantic salmon, speckled trout, lake trout, melt, maskinonge, pike-perch (yellow pickerel), small- and large-mouth black bass and burbot.

Wildlife is a comparatively new field of research in Ontario. Prior to the creation of the Ontario Research Commission and the reorganization of the Department of Lands and Forests almost the only wildlife research carried on in Ontario were faunal surveys and population studies by the Royal Ontario Museum of Zoology and parasite studies by the Ontario Research Foundation. Notable exceptions were the studies of the periodic fluctuations of the population of grouse and hares by two graduate students, Clarke and MacLulich, of the University of Toronto.

Expansion of wildlife research has been delayed as compared with fisheries research through lack, until recently, of a sufficient supply of trained personnel. Now that this deficiency is being remedied it is hoped that wildlife research will increase more in keeping with its importance.

Animals on which research is being continued or initiated include moose, woodland caribou, white-tailed deer, muskrat, European hare, mice and other small mammals, ruffed grouse, prairie chicken, pheasants, upland game birds and ducks.

Diseases and parasites of fish and wildlife are receiving attention since they often have an important influence on the size of animal populations. Not only are they important in the control of animal numbers but it is possible that there is a closer relation between some human and animal diseases than is generally believed. Their importance warrants much more research than has heretofore been devoted to them.

### Organizations Engaged in Research

A list of the organizations engaged in fisheries and wildlife research supported by the Research Council of Ontario together with a statement of the researches undertaken by each with Council support may be found elsewhere in this report. In addition fisheries and wildlife research is carried out by the Department of Lands and Forests and the Department of Planning and Development.

### Co-ordination of Research

Since research is being carried out by so many and such a variety of organizations, some integration is desirable. To bring about such integration is one of the functions of the Committee. This is effected through interchange of information at meetings of the Committee, through formal and informal conferences and through the distribution of research reports. The work of the Committee also tends to bring about a balanced program by encouraging the initiation of research in important phases which appear to be receiving too little attention.

Technical sessions are held at the end of February or beginning of March for the presentation and discussion of the results of research carried out the previous year. Those engaged in research, including students both postgraduate and undergraduate, present their results at a meeting attended not only by research workers from Government departments, universities and research organizations but also by administrators and those engaged in industries dependent on the fish and wildlife resources. These technical sessions are not only a valuable means of spreading information but they give students practice in the preparation and presentation of the results of their studies.

There are many studies which cannot be called fish and wildlife research but which nevertheless have an application in the production and management of fish and wildlife. Such are forestry, including forest entomology, and soil studies. Exchange of information between Committees in charge of these subjects and the Fish and Wildlife Committee is effected through formal meetings and informal discussions arranged by the Director of the Research Council.

Interchange of ideas and information between those engaged in fisheries and wildlife programs under Federal auspices and those of the various provinces are furthered through annual meetings of the Canadian Committee on Freshwater Fisheries Research and Committees on Freshwater Fisheries Research and Terrestrial Wildlife of the National Research Council.

## Fundamental and Applied Research

Research is carried out through three types of organizations—Government departments, universities and organizations created specifically to do research. Each of these is peculiarly qualified to do a particular kind of research and it is one of the functions of the Advisory Committee to see so far as possible that each type of organization carries out the kind of research for which it is specially adapted.

Balance as between fundamental and applied research is sought by the Advisory Committee on Fisheries and Wildlife. If pressure to secure early answers to urgent problems in the management of resources leads to too little attention being paid to fundamental research, it will ultimately injure even practical research. Fears are being widely expressed in many fields of science that fundamental research is today receiving totally inadequate support. There is not too much practical research, only too little fundamental research.

It is generally agreed that universities are the homes of fundamental research. If university research is not adequately supported or if universities do not devote themselves to the pursuit of the basic knowledge necessary as a firm foundation for broad applications the whole structure of science will suffer. The support given the universities through the Research Council has made possible the initiation of many research projects in biological fields basic to fisheries and wildlife management.

Studies aimed at the elucidation of basic factors underlying the productivity of waters and the behaviour and reactions of fish to the various conditions which they meet in nature are also receiving attention. Similar studies concerning terrestrial animals have also been initiated.

## The Training of Research Personnel

The most valuable contribution to research in the fields of fisheries and wildlife to date has been in the training of personnel rather than in the information obtained, although the value of the latter is considerable.

Much of the research carried out to date has been done by students both postgraduate and undergraduate under the direction of senior men in Government departments, universities and research organizations. Of the 128 persons engaged in research during 1948, 28 were postgraduate students and 53 undergraduate. Not all of these will become fully qualified either as research or administrative personnel but their potential value through employment in the fields of fish and wildlife research and management are infinitely greater than the contribution they have made or will make as students.

## Need for Long-Term Research

The need for studies in fisheries and wildlife over a long period is not generally appreciated. Long continued observations are necessary because of the number of factors affecting the survival and growth of animals in nature and the great variability of such factors as temperature, moisture, light, cover, food, predators, competitors, parasites, disease, etc.

In wildlife the need for prolonged observations may be illustrated by reference to the moose. As a result of Peterson's recent studies on the moose it appears that moose find suitable food at a certain stage in forest succession. If an area is burned or cut over, return to the original or some other climax condition takes place through a succession of stages. From 5 to 20 years after the burn or cut, depending on conditions, shrubs and young trees reach a size which supply moose food. Later and especially when the forest is mature there is nothing for moose



to eat except at the edges around bogs, marshes and lakes and in other forest openings. Other game and fur-bearing animals and even forest insects have a definite relationship to forest conditions. To understand these relationships as a basis for forest management if wildlife and insects are a concern, it is necessary to study forest biology on some suitable area over a long period tracing the changes in the vegetative cover from herbs to trees and the accompanying changes in animal life—moose, deer, fur-bearers, birds, insects, etc., etc. Separate studies at different places and at different times, as forestry, zoology and forest entomology, will not give the same understanding of inter-relationships as simultaneous studies on the same area.

Many fisheries problems also require long-term studies for their solution. The populations of some species in the Great Lakes vary tenfold and more from one time to another. Sometimes one species will be abundant, sometimes another. Are these fluctuations due to differences in meteorological conditions, to changes in the food supply, in the effect of competitors or predators, to disease or to some combination of two or more of such factors? It usually requires more than 10 years, sometimes many more, to follow the cycle of events involved in such changes. If studies requiring many years are discontinued or interrupted before completion a large part of the value of the work already done may be lost. This was illustrated by the results of a Pacific herring study carried out by the Fisheries Research Board of Canada. After 17 years, results of great practical value were realized if the study had been discontinued after 15 years perhaps three-quarters of its practical value might have been lost.

### The Future of Fisheries and Wildlife Research

Expansion of permanent research organizations must be planned for the immediate future unless Ontario is to lose much of the value obtained to date in the training of research personnel.

When the Research Commission was appointed the supply of men trained in fisheries and wildlife research was small and confined largely to university staffs. Most of those who had taken postgraduate training in Ontario had gone into Federal organizations or to other provinces. As a result of support given by the Commission, many students have been employed in research during the past three years. Some of these have completed postgraduate training and many more will complete it in the near future. Unless Ontario is to lose these trained research workers, provision must be made for employing them in organizations already carrying on research and in the creation of new openings. The need for long-term, integrated researches poses a challenge to bring the men and the means for research together.

### Reports

Abstracts of Papers, Technical Session, Feb. 27-28, 1948.

Abstracts of Papers, Technical Session, March 4-5, 1949.

Progress Report on Fisheries and Wildlife Research Projects, R.C.O. No. 3-1-4

Progress Report on Fisheries and Wildlife Research Projects, R.C.O. No. 3-2-4

## ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Dean J. W. B. Sisam

Secretary: Dr. H. Borden Marshall

The Advisory Committee on Forestry Research was set up in 1946 with the general objective of advising the Research Council of Ontario (at that time known as the Ontario Research Commission) on matters relating to scientific research in the field of forestry. In the terms of reference under which this Committee acts, "forestry" is used in a broad sense to include all aspects of forest production and wood utilization. The Committee, therefore, with members from government services, forest industries and the universities, represents a wide range of interests and activities, all within the general field of forestry.

In order to provide a background for its future work, the Committee in the first place prepared reports on the general situation with respect to forest production and wood utilization in the Province, and made recommendations for future action. Following this a general program of subjects requiring investigation was drawn up. This program was published in the Final Report of the Ontario Research Commission (1948).

Since its formation the Committee has met two or three times each year. While some of these meetings have been held in Toronto, it has been the general policy of the Committee to meet in different parts of Ontario and even outside the Province, in order that the members may visit woods operations, forest research projects, and one or other of the wood-using industries. This affords an opportunity for all members of the Committee to become acquainted, in general terms at least, with the different aspects of forestry in Ontario.

The Committee has considered the research requirements in the field for which it is responsible in two ways:

- (1) With reference to specific problems that are of urgent importance and on which research should be initiated or, if already started, should be expanded;
- (2) With reference to subdivisions of the major fields of forest production and wood utilization, in each of which a number of more or less closely related problems may require immediate attention.

In either case sub-committees are set up to implement the recommendations of the Advisory Committee and otherwise carry on the work of the Advisory Committee throughout the year. These sub-committees are either of a temporary nature, formed to direct the work on a specific project and dissolved when that work is completed, or are on a continuing basis, established to study comprehensively the research requirements in some branch of forestry, to make recommendations to the Advisory Committee, and to initiate and supervise projects as required.

### Meetings During 1948

The Advisory Committee on Forestry met twice during 1948. At the first of these meetings, held in Montreal on March 9, 1948, in addition to considering the reports of projects then under way or already approved for future action, the Committee discussed at length the problem of birch die-back. This condition, the primary cause of which is unknown, has resulted in heavy mortality of white and yellow birch in the Maritime Provinces, and appears to be moving westward. A sub-committee was set up to prepare a report on this matter.

Following the meeting, members of the Committee visited (a) the mill of the Wayagamack Division of the Consolidated Pulp and Paper Corporation, Three Rivers, P.Q., (b) the Paper Makers' School, Three Rivers, P.Q., and (c) the Pulp and Paper Research Institute of Canada, Montreal.

The second meeting of the Advisory Committee during the year was held on August 30th and 31st at the Petawawa Forest Experiment Station of the Dominion Forest Service near Chalk River, Ontario. At this time, in addition to the regular interim reports on projects sponsored or supported by the Committee, papers were presented on various aspects of research being undertaken by the Dominion Forest Service, the Ontario Department of Lands and Forests, and the Forest Entomology and Pathology Divisions of the Dominion Department of Agriculture.

These included:

- (1) "Fire Hazard Research", by H. W. Beall, Dominion Forest Service.
- (2) "Birch Die-back", by Dr. J. M. Cameron, Forest Insect Laboratory, Saul Ste. Marie.
- (3) "White Pine Blister Rust", by Dr. J. E. Bier, Dominion Laboratory of Forest Pathology, Toronto.
- (4) "Seed Handling", by A. P. Leslie, Ontario Department of Lands and Forests.
- (5) "Forest Soil", by G. A. Hills, Ontario Department of Lands and Forests.
- (6) "Policy on Regeneration"
  - (a) by G. Tunstell and R. H. Candy, Dominion Forest Service
  - (b) by R. N. Johnston, Ontario Department of Lands and Forests.
- (7) "Regeneration of Wild Scrub Areas in Southern Ontario", by A. S. L. Barnes, Ontario Department of Planning and Development.
- (8) "Forest Genetics", by J. L. Farrar, Dominion Forest Service.

Following this meeting, members of the Committee visited (a) forest research projects at the Petawawa Station, and (b) the Ontario Hydro Commission development at Des Joachims, P.Q.

## Sub-Committees

### Sawmill Practice and Equipment

**Purpose**—In view of the lack of development in small sawmill equipment and of the general inefficiency and poor quality of lumber produced by these mills it was recommended that a survey be made of all types of existing sawmill equipment in different countries, and that a report be prepared thereon. At the suggestion of the sub-committee this survey was placed in charge of Professor W. C. McIntosh, Department of Mechanical Engineering, University of Toronto.

**Progress**—A preliminary report on this project was presented to the Advisory Committee in September, 1947. Subsequently it was recommended by the Committee that the survey be extended along the lines suggested by the sub-committee, i.e., to secure all information possible on foreign sawmill machines and practice to prepare diagrams of various types of existing equipment, and give a clear indication of the mechanical features in each case, to collect all information possible from manufacturers and other sources with regard to saws, and to give some attention to obtaining data with regard to sources of power for sawmill operation.

This survey was completed during 1948. The final report is in the course of preparation and it is expected will be presented to the Advisory Committee during the first half of 1949.



## Waste Slabwood Utilization

**Purpose**—To investigate methods of debarking logs and slabwood with a view to a closer utilization of sawmill waste for pulp.

**Progress**—This project was placed under the direction of Professor I. W. Smith, Department of Mechanical Engineering, University of Toronto. Investigation was carried out during the summer of 1947, and a report was presented to the Advisory Committee in September of that year. In March, 1948, Professor Smith presented this report at the Annual Meeting of the Forest Products Research Society in Chicago.

## Birch Die-Back

**Purpose**—To investigate and report on the situation with regard to birch die-back in Ontario.

**Progress**—This problem has been studied by the sub-committee, and it is expected that a report will be presented at the meeting of the Advisory Committee on May 1st and 2nd, 1949.

## Wood Chemistry

**Purpose**—To study and report on research problems in the field of wood chemistry that are of importance to the wood-using industries in Ontario, and where necessary to indicate the laboratories where such research could be carried on.

**Progress**—(a) The following topics have been studied by individual members of the sub-committee and others appointed by it. Reports have been prepared on the results of this work, and these in most cases will be published in the Pulp and Paper Magazine of Canada early in 1949.

- (1) "The Electro-Chemical Treatment of Lignin Solutions", by F. Bender, Forest Products Laboratories, Ottawa.
- (2) "Liquid-Liquid Extraction of Waste Sulphite Liquor", by R. R. McLaughlin, Department of Chemical Engineering, University of Toronto.
- (3) "Mold Fermentations on Waste Sulphite Liquor", by G. A. Ledingham, National Research Council Regional Laboratory, Saskatoon.
- (4) "A Survey of the Utilization of Waste Sulphite Liquor by the Tanning Industry", by A. M. Johnson and H. Borden Marshall.
- (5) "Utilization of Waste Sulphite Liquor with Special Reference to the Magnesium Bisulphite Recovery Process", by G. H. Tomlinson, II, Howard Smith Paper Mills.
- (6) "The Oxidation of Waste Sulphite Liquor", by G. F. Gardiner, Forest Products Laboratories, Vancouver.
- (7) "The Preparation of Exchange Resins from Waste Sulphite Liquor", by Dr. P. E. Gagnon, Laval University.

(b) On the recommendation of the sub-committee, a review of the literature on the utilization of waste sulphite liquor from 1943 to the end of 1948 has been made by Mr. P. C. Crumley at the Ontario Research Foundation. The results of this work will be made available in the Province of Ontario by the Research Council of Ontario and also through the Canadian Pulp & Paper Association to members of that Association.

This review carries forward the work that has already been done on the literature of this subject, first for the period up to 1918 by Messrs. B. Johnson and T. W. Hovey in Bulletin 66 of the Forestry Branch, Dominion Department of the Interior and later for the period 1918-43 by Messrs. B. E. Mead, B. F. Patterson and G. F. Pepper under the auspices of the Ontario Paper Co. Ltd., Thorold, Ontario.

(c) The sub-committee has recommended that steps be taken to promote wood chemistry research in the universities of Ontario and more especially that information about the material prepared by the sub-committee be brought to the attention of the chemistry departments of these universities with a view to having them take a greater interest in this particular field. It may be worth noting that one of the provincial universities is at this time making preparations to give in future instructions in pulp and paper chemistry.

(d) The sub-committee also has under its supervision research on the following projects, which is being carried out at the Ontario Research Foundation:

1. Utilization of white birch.
2. Essential oils from Canadian trees.
3. Tanning agents from lignin.

Progress reports on these projects are submitted to the Advisory Committee on Forestry from time to time.

### Biological Forestry

**Purpose**—To study those aspects of forest production concerned with the regeneration and growth of trees and their destruction by insects and disease, and to make recommendations to the Advisory Committee on research requirements in these fields.

**Progress**—The sub-committee recommended that a survey be made of information presently available from regeneration surveys as carried out by all agencies within the Province. This recommendation was approved by the Advisory Committee. The project was placed in charge of Professor R. C. Hosie of the Faculty of Forestry, University of Toronto, with the following plan as a guide to the work to be undertaken:

1. To secure copies of all the reports that have been made for areas studied within the Province.
2. To obtain copies of the survey data where reports have not been made.
3. To analyze these reports and the survey data for the purpose of making possible a uniform evaluation of the results.
4. To visit the companies submitting reports and observe in the field the actual conditions on which the reports are based.
5. To spend a week or two with the Dominion Forest Service for the purpose of correlating survey methods.

### Reports

"Forestry and Forest Research", by G. R. Elliott, Timber of Canada, Vol. No. 9, May, 1948.

"Mechanical Methods of Bark Removal", by Irvine W. Smith, Forest Products Research Society, Preprint No. 15, March, 1948.

"New Uses of Wood", by H. Borden Marshall, Canadian Chemistry and Process Industries, September, 1948.

"The Utilization of Waste Sulphite Liquor", April, 1949.

"Sawmilling, Preliminary Report on Small Sawmilling Equipment", April, 1949.

## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Mr. W. S. McKay

Secretary: Mr. H. N. Lamont

On the initiative of the Ontario Good Roads Association, as embodied in a resolution at its 1947 Convention, this Committee was established as an advisory committee of the Ontario Research Commission in the spring of that year.

The report of its work for that year contained two recommendations:

1. That a highways research library should be established with a full time, trained librarian in charge.
2. That a highways research program be now undertaken and that the following subjects be given priority of consideration in such a program:
  - (a) Supporting value of subgrade soils and base courses,
  - (b) Soil compaction and frost action of subgrade soils,
  - (c) Durability of bituminous and concrete aggregates,
  - (d) Inventory of granular materials,
  - (e) Design of concrete and bituminous pavements.

Subsequently study of library recommendation, while confirming the need, has so far not resulted in the establishment of this essential aid to research—viz. ready access to the recorded results of research and facts already known. Since investigation showed that accommodation for such a library was not readily available in or about Queen's Park, consideration is being given to the possibility of locating it in the Department of Highways Laboratory on Sheppard Avenue.

Definite progress has been made during 1948 in the carrying out of a research program by the Department of Highways and Queen's University on two of the five research subjects, namely:

- (a) Supporting value of subgrade soils and base courses,
- (d) Inventory of granular materials,

and the results of this work are embodied in an illustrated report entitled "Highways Research in 1948" prepared by Mr. John Walter, of the Ontario Department of Highways and published by the Research Council of Ontario as Report No. 5-1-49.

The work of the Advisory Committee is carried on principally through five sub-committees, viz:

Organization,  
Planning, Economics and Administration,  
Soils and Foundations,  
Design,  
Materials and Construction.

Since much of the ground work and much of the detailed work and preliminary planning is done in these sub-committees, their meetings are more frequent than those of the general Advisory Committee to which the sub-committees ultimately bring their reports.

The principal 1948 meeting of the general Committee was a two day session, devoted to the presentation of papers and a visit to the Laboratories of the Department of Highways and the Hydro-Electric Power Commission.



Three hundred and fifty copies of a fifty page booklet embodying the addresses presented on that occasion were published by the Research Council of Ontario as Report No. 5-1-48 and mailed to highway engineers of the Province. The value of this publication may be gathered from the following "Contents" page:

Introduction to Research for 1948, R. A. Low

An Outline of the Physiography of Southern Ontario, L. J. Chapman

Soil Engineering, John Walter

Soil Mechanics, R. F. Legget

Supporting Power of Subgrades and Base Courses, Norman W. McLeod

Inventory of Granular Materials in the Province of Ontario, T. F. Francis

Miscellaneous Research, John Walter

Training of Personnel, R. A. Low

Application of Research, D. J. Emrey

Excerpt from the Final Report of the Ontario Research Commission, January, 1948.

Glossary of Soil Engineering Terms.

The progress of each year has been reported to the annual meetings of the Ontario Good Roads Association with a view to maintaining the interest and continued support of the members of that Association. That this end is in some measure, at least, being achieved, is evidenced by the fact that that Association in conjunction with the Research Council is presently considering the possibility of establishing a Highways Research Scholarship, to assist in providing for some of the trained personnel, now in short supply, necessary to the furtherance of the research program.

The paramount importance of the Department of Highways in the carrying out of any highways research program, has been already well exemplified in the work of the past two years and it is gratifying to this Committee that the Minister of Highways directed attention to this important phase of the Department's work in his address to the Ontario Good Roads Association, February, 1949.

## Reports

"Papers Presented at Highways Meeting Held on May 20-21, 1948", R.C.O. Report No. 5-1-48.

"Highways Research in 1948", J. Walter, R.C.O. Report No. 5-1-49.

## ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: Mr. C. A. Pollock

The Ontario Research Commission set up a Commission committee under the chairmanship of Mr. E. T. Sterne. The Committee included representatives from the Canadian Manufacturers' Association, the Ontario Research Foundation, the Department of Planning & Development, industry and the Ontario Research Commission.

The Committee went into the whole question of research in industry. In particular it endeavoured to develop ways and means for ensuring that research results that are available were more generally applied to Ontario industry.

## Industrial Research Services

The work done under the Committee's direction in connection with the Industrial Research Services Division of the Ontario Research Foundation can best be described by quoting from the 1948 report of the Foundation:

"This Department was established two years ago on the recommendation of the Ontario Research Commission and with the financial support of the Provincial Government. Its objective has been to secure and to present in appropriate form, scientific and technical information for industrial companies in this Province. We hoped to help in particular the large number of smaller firms, greatly increased in numbers in recent years, and which possess no laboratory facilities or scientifically trained personnel. Sufficient time has now elapsed to write with reasonable confidence about this important experiment.

At the present time the staff is composed of the Director, four graduate assistants and two secretaries. Their time is fully occupied in visits to plants, interviews at the Foundation, contact with the laboratories and the preparation of reports. As one might have expected from his overseas record, the Director has not only organized the work on sound and efficient lines but introduced a spirit into the whole effort which has rapidly won the confidence of our clients and the scientific staff.

Statistics cannot tell the story in any adequate way but the following are striking figures: over 2,000 firms or individuals have asked the Division for assistance. Of these over 700 have used the service on more than one occasion. In 900 cases the enquiry has necessitated laboratory work in some form. During the year 790 visits to plants or offices have been made. These calls are becoming increasingly important as they gradually change from a courtesy call into a visit which occupies several hours and involves a detailed discussion of current problems.

The steady growth of this work has had important repercussions on the scientific laboratories of the Foundation. In the first place it has put short-term work and testing on a far more efficient basis and has taken from the research men, particularly the seniors, a large part of the responsibility. This has resulted in fewer days completely spoiled for experimental work by telephone calls and visitors. Gradually the laboratory work is being concentrated and performed by full-time workers. The list of requests for this type of service covers everything relating to the widely diversified manufacturing activities of this Province. Our existing facilities in equipment and personnel cannot possibly handle the load, and with the approval of the Board I submitted a recommendation to the Research Council of Ontario asking for financial assistance to support suitably equipped laboratories to handle enquiries from the food industries and those requiring research in the field of applied physics. The need for such facilities will be obvious when it is realized that in spite of steadily growing regulations controlling the composition and sale of foods there is no laboratory in the Province to which a small manufacturer can turn for accurate determinations of the vitamins. Similarly there is a growing need for assistance in the field of applied electronics.

It would be easy to gain the impression that the bulk of this work is of a simple and routine character. In point of fact a large proportion of the joint efforts of this Department and the laboratories have been concerned with development work, and I have watched with very great interest the gradual evolution of a question or an idea into a product manufactured and sold.

There is an old saying that if you try to please everybody you end up by pleasing nobody. I believe that the difficulties which are inherent in a piece of public service of this nature will be obvious to members of the Board. That there has been no cause for anxiety is due to the fact that my senior colleagues have

gradually worked out and put into printed form simple rules and a policy which is in keeping with the primary objective and fair to all concerned. This policy has been interpreted with simple sincerity by the entire staff of this Service."<sup>1</sup>

### Group Research

The idea of research on a common problem by a group of two or more companies which was suggested in the original Canadian Manufacturers' Association submission has been developed. One such group research has been initiated with four of the steel companies, and other group projects are under study. Group research projects may arise in any of the advisory committees but they are developed in detail by the Ontario Research Foundation and are finally approved for action by the Research Council.

The Ontario Research Commission early in 1948 had recommended enlarging the Committee to have wider industrial representation. As a result, the Committee was expanded during the year.

### Canadian National Exhibition

In co-operation with the Trade & Industry Branch of the Department of Planning & Development and the Ontario Research Foundation, a research display was arranged at the Canadian National Exhibition. Research equipment in operation was on display. The large physiographic map of Southern Ontario which had been prepared by Mr. L. Chapman of the Ontario Research Foundation and Prof. D. Putnam of the Department of Geography, University of Toronto, formed a suitable background.

The Chairman of the Committee since its inception was Mr. E. T. Sterne. His death on February 2nd, 1949, was a great loss. Mr. Sterne by his energy, wide experience and personality had been responsible for much of the development of the work of the Committee. Early in the year the Council decided to extend the scope of the Committee's activity by making it a regular advisory committee. With the death of Mr. Sterne, the Council gave this matter consideration and as a result, set the Committee up as a regular advisory committee and asked Mr. C. A. Pollock of Kitchener to act as Chairman.

## COMMITTEE ON INDUSTRIAL WASTE

The Committee on Industrial Waste has continued as essentially a Council Committee. Until his death, Mr. E. T. Sterne acted as Chairman, and his interest and contact with the problems was a great stimulation to the work of the Committee.

During the year work was carried on in co-operation with the Provincial Department of Health. The problem chosen for work was to investigate methods and to develop better techniques for the disposal of milk wastes from the smaller processing plants. These plants require a simple, economic system for waste disposal. A preliminary report has been prepared and work is continuing.

The Wood Chemistry Sub-Committee of the Advisory Committee on Forestry Research conducted a comprehensive survey into the utilization of waste sulphite liquor. The papers were prepared by leading workers in each field and were published in the Pulp and Paper Magazine of Canada.

Other projects are under consideration and it is hoped that research will enable each unit of industry to have available the knowledge necessary to economically dispose of its wastes.

### Reports

R.C.O. No. 7-1-48, "Progress Report, Milk Waste Research", N. D. Woollings

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<sup>1</sup>Annual Report of the Ontario Research Foundation, 1948.



**ADVISORY COMMITTEE**  
**on**  
**MINES, MINERALS AND METALLURGY RESEARCH**

Chairman: N. F. Parkinson

During 1948 certain changes, looking to the more effective conduct of the Committee's work, were brought about in the set up of sub-committees of the main advisory body.

Previously sub-committees, where new problems were initially studied prior to their presentation to the Main Committee, had been active in the fields of wire rope and electric smelting. This year the Sub-Committee on Electric Smelting was divided into two, to deal with problems respectively on Ferrous and Non-Ferrous Metallurgy. Two additional sub-committees were appointed or provided for—one on Geology and the other on Industrial Minerals.

Advancement of available information as a result of the various investigations under way during the year, is summarized under the sub-committee fields as follows:

**Wire Rope**

A most complete bibliography of available data on uses, performance and testing of wire ropes was set up and is now available in the office of the Council. The various references are contained on cards which may be readily added to from time to time and so kept up to date. The information in this form is an invaluable aid to those concerned in following developments and safe practices in the use of wire rope in mining and in other industrial applications where safety and economic use go hand in hand.

The year marked the completion of the specially designed test machine for use in examining special features that may be exhibited in the continuing use of wire rope under varying stress conditions. This is being done in order that safety rules with proper economic limits may be developed.

A program of special test work, utilizing the machine on  $\frac{3}{8}$ " diam. steel wire rope has already been drawn up for 1949 attention.

It is of interest to note in this regard that one of the larger oil companies has duplicated the machine developed by the Council and plans to engage the Ontario Research Foundation for the conduct of parallel experimentation looking to the gathering of data having to do with all phases of rope lubrication.

**Ferrous Metallurgy**

The electric smelting of iron ores was made the subject of a short review by a member of the staff of the Ontario Research Foundation. Some ore from one of the Ontario iron mines was sent to Sweden especially for the purpose and subjected successfully to direct reduction tests in the Wiberg furnace. The results of this work were published in a paper written by Mr. P. E. Cavanagh. Since, however, it is obvious that the future successful use of this process is largely dependent upon economics, power availability and cost being the deciding factors, no further work along this line is contemplated for the present.

In the light of the present shortage of scrap and the possible emergent need for supplies of a suitable substitute in future, the brick kiln process of iron ore reduction was also investigated in a preliminary way in the summer of 1947. The results of this investigation were reported on, also in a paper by Mr. Cavanagh, presented at the annual meeting (1948) of The Canadian Institute of Mining and Metallurgy, and the process has developed into a matter of some importance since

four Ontario steel companies and one of the larger extra-Provincial companies have indicated their desire of participating with the Government in a plan to set up a semi-commercial test unit where more complete data applicable to local conditions, may be gathered.

In addition, and as an aid to this type of development, the Committee contemplates the conduct of some direct experimental work on two allied subjects:

(1) pelletizing of iron ore; (2) use of oxygen in the blast furnace.

Some preliminary work has already been done on the pelletizing problem, with most encouraging results as to product and costs.

### **Non-Ferrous Metallurgy**

No special projects were underway in 1948 or contemplated for 1949.

### **Geology**

While the Sub-Committee on Geology has only recently been provided for, a number of projects falling under this heading were given some attention during the year.

Thermal, Gravimetric and Seismic studies were assisted, with a view to aiding geological determinations and preparing for deep level mining in Ontario mines. Certain work on the determination of minute quantities of the rare minerals in rocks by the use of the Spectograph, and an X-Ray diffraction research, with a view to the development of a more orderly economic classification of our rock structures, were assisted in a small way. The data obtained will be studied with a view to considering the advisability of proceeding further along any of these lines.

### **Industrial Minerals**

No projects were conducted along this line during the year. The special committee just formed will examine carefully into the field and its requirements in future.

### **Conclusion**

Since all the members of the Committee and the Sub-Committees act voluntarily, it is more than fitting that mention should be made at this time of the serious and earnest manner in which the many problems coming forward for consideration are dealt with. Many meetings of the committees have been held throughout the year and a large proportion of the members come from outside of Toronto. To all are due thanks for their advice and time so well and freely given.

### **Reports:**

"Thermal and Radioactive Studies, 1947-49"—J. Tuzo Wilson—R.C.O. No. 8-1-48.

"Investigations in Radioactivity and Structure of the Canadian Shield, 1948"—J. Tuzo Wilson—R.C.O. No. 8-1-49.

"Report on Geochemical Studies"—H. S. Armstrong—R.C.O. Report No. 8-2-49.

"Review of Recent Geophysical Work in Canada"—J. Tuzo Wilson—Trans. American Geophysical Union—No. 1, February, 1948.

"Approach to the Structure of the Canadian Shield"—J. Tuzo Wilson—Trans. American Geophysical Union, Vol. 29, No. 5, October, 1948.

"Economics of Ferrous Smelting in Canada"—P. E. Cavanagh—C.I.M.M.E., Vol. 51, 1948, pp. 205-215.

## ADVISORY COMMITTEE ON SOILS RESEARCH

Chairman: Dr. H. B. Speakman

Secretary: Mr. L. J. Chapman

During 1948 this committee met twice at Toronto on July 5th and September 27th, with nine and eight members in attendance.

The first meeting on July 5th served mainly for an exchange of information as to what work was being undertaken during the 1948 season.

### Ontario Agricultural College Program

Professor Ruhnke reported that the Ontario Agricultural College was carrying on surveys to describe, classify and map the soils in the four counties of Lambton, Stormont, Grey and Bruce. Parties of two men are working in each case. With the completion of these counties there will then remain 10 counties in Southern Ontario to be studied in this way. When they have been dealt with it will be possible to give a comprehensive account of the soils of this important agricultural area.

Several projects are under way, undertaken in co-operation with other departments at the College. They are studies of:

- (a) The effect of magnesium applications on tobacco.
- (b) Fertilizers for table turnips so as to get desired size, shape and flavour.
- (c) Whether the failure of clover seed setting can be attributed to deficiencies of major or minor elements of soil fertility or to soil moisture. Climatic records in two fields are part of this study.
- (d) The effect of sulphur dressings on the soil in reducing potato scab.

Professor Ruhnke also reported that the demand for assistance in farm planning from their soil conservation section was greater than they could serve. It therefore seems necessary that the farmers' requests for such a service should be met.

To assist the farmers on the hilly lands of Waterloo County, and on similar soils elsewhere, installations to measure the runoff of water and the soil losses have been made at New Hamburg.

### Vineland Program

Professor Palmer mentioned the studies of microbiological activity in Vineland soil which had been treated in different ways. This work of Professor Chase was an outgrowth of deliberations of the Advisory Committee on Soils. The soil under sod mulch was more active than that under sod without a mulch of grass or that under a system of clean cultivation. These results are in keeping with the observed growth and fruiting of peach trees at the Vineland Station.

The method used measures the biological activity without knowing the identity of the organisms concerned.

### Department of Lands and Forests Program

Mr. Hills reported on the soils research of the Department of Lands and Forests. Survey parties were working in the region between the southern edge of The Shield and North Bay. One objective was that of distinguishing between agricultural and forest land. Another was to provide information to those foresters who want to know what tree species to plant or promote on certain sites.



## Ontario Research Foundation Program

The Ontario Research Foundation has not found it possible to start a physiographic study this year in conjunction with their survey. They undertook no new field work, but elected instead to complete the writing of the account of the physiography of Southern Ontario.

In the field of climatology, equipment to measure evaporation from a given area of sod, similar to the one carried on last season in Toronto, was installed at the Dominion Experimental Station, Kapuskasing, under Mr. Goring's supervision. From this, figures applicable to Northern Ontario will be available and will supplement those taken at Toronto.

Another co-operative project was started this spring in an attempt to work out a system of irrigating at the Forestry Nursery, Orono.

The meeting on September 27th provided opportunity for further discussions and for the presentation of requests to the Ontario Research Council to be included in the 1949 budget.

## Microbiology

Professor Palmer first remarked that at the end of the very severe drought of 1948 the peach trees under sod mulch at the Vineland station were "much too" healthy in comparison with other sections of the orchard. Since the reason appeared to be microbiological he stated the opinion that the soil studies most likely to produce fruitful results to agriculture were those along microbiological lines.

The matter of how such studies could be implemented, in agriculture and forestry was discussed at length. A sub-committee was appointed to draft a plan of action. A meeting of this sub-committee on October 29th reviewed the foremost problems of a microbiological nature in agriculture and forestry. In horticulture the increased fruit crops due to mulching the soil with hay has been great enough to encourage further experiments with peaches, apples and other crops. Moreover, the effect of soybean hay and chopped corn stover in controlling root rot of strawberries illustrates a method of attacking certain soil-borne diseases of crops.

In forestry one pressing problem is to learn how to induce the decomposition of the peat which forms the surface layer of the soil in large areas of Northern Ontario. The regeneration and good growth of spruce seems to depend upon the solution of this problem.

The sub-committee has, therefore, recommended that an effort should be made to establish (a) one man in forestry and (b) another man in agriculture who would initiate studies in one or more phases of the above mentioned problems.

In reporting on their summer's work, Mr. Hills stressed the observation that different trees growing on similar sites make certain important changes in the soil in that place. As a result, silviculturists may in future plant a mixture of species in order to keep the soil in good condition.

## Land Classification

The current work of the Department of Planning and Development in land classification for the purposes of watershed improvements was covered by Mr. Creswick. Surveys in 1948 involved about 1,000 square miles of the Moira watershed and a similar area along the Napanee River.

Mr. Chapman advised that the preparation of a monograph on the physiography of Southern Ontario was in its final stages. A large map of the surface

features has a central place in the work and there are many small maps and illustrations. The text is of approximately 160,000 words or 450 pages. The cost will approximate \$13,000.00.

Following earlier discussions of this Committee, the question of starting a physiographic survey of Northern Ontario was brought up. The Ontario Research Foundation was prepared to extend their survey into that area if assistance could be obtained. Specifically, they asked for one man who could be trained in this work. It was suggested that later another man would be obtained to make a team who could carry out the survey. After some discussion a majority of the Committee members thought that two men should be secured and set to work without further delay.

## Climatology

Mr. Chapman presented a progress report on the climatic research of Mrs. Marie Sanderson. Incidentally, this was the first project supported by the Ontario Research Commission. During the year the results of an experiment to measure evaporation from sod under conditions of abundant moisture was published. Also an account of the Climates of Canada according to the Thornthwaite classification has been completed and was presented to the Soils and Agronomy section of the Agricultural Institute in June.

As an outgrowth of this general work in climatology an experiment in irrigating young pine seedlings was conducted this summer in co-operation with the Forestry Station at Orono. Using the Thornthwaite tables to compute evaporation rates (or soil moisture) beds of 2 year old red pines were irrigated systematically. Whereas these seedlings are customarily grown under a cover of slats which provide shade, the slats were removed and the seedlings grown in full sunlight. The young trees grown under this system of culture outstripped those grown under screens and irrigated in the regular manner at the Nursery. The Orono Station expects to change their system throughout the nursery which will eliminate the cost and care of the screens and, according to last summer's results, will result in producing trees big enough to set out in three years instead of four. Next season an attempt will be made to grow the seedlings from seeds in the open, eliminating the screens (slats) entirely.





# APPENDIX I

## BUDGET

### ADMINISTRATION:

Salaries .....	12,152.51		
Maintenance .....	3,095.33		
Travelling:			
Research Council .....	2,361.89		
Advisory Committees .....	1,695.68	4,057.57	19,305.41

### SCHOLARSHIPS:

47,420.00

### GRANTS:

#### A.—By Agency

#### Ontario Research Foundation

Wire Rope .....	17,907.68		
Ferrous Metallurgy .....	19,261.83		
Parasitology .....	29,902.72		
Physiography .....	19,195.66		
Wood Chemistry .....	26,477.14		
*Industrial Research Services .....	43,144.15	155,889.18	

#### University of Toronto

Biology .....	14,300.00		
Pharmacology .....	3,000.00		
Geophysics .....	9,000.00		
Mineralogy .....	7,000.00		
Applied Science .....	5,000.00		
Forestry .....	7,000.00	45,300.00	

#### Royal Ontario Museum of Zoology

Biology .....	14,000.00	14,000.00	
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#### McMaster University

Biology .....	18,000.00		
Geochemistry .....	3,000.00	21,000.00	

#### Queen's University

Biology .....	10,500.00		
Mineralogy .....	18,000.00	28,500.00	

#### University of Western Ontario

Biology .....	3,140.00	3,140.00	
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#### Department of Health

Milk Waste Disposal .....	5,426.25	5,426.25	273,255.43
			<u>339,980.84</u>

\*Carried in Department of Planning and Development Budget.

# GRANTS:

## B.—By Committee

Committees	Supervisor		
<b>Fisheries and Wildlife</b>			
Fisheries	F. E. J. Fry	12,000.00	
Pharmacology	J. K. W. Ferguson	3,000.00	
Wildlife	A. F. Coventry	1,400.00	
Zoology (Museum)	J. R. Dymond	14,000.00	
Biology	A. E. Warren and N. W. Radforth	18,000.00	
Biology	H. W. Curran	6,000.00	
Limnology	J. D. Detwiler	3,140.00	
Parasitology	A. M. Fallis	29,902.72	87,442.72
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<b>Mines, Minerals and Metallurgy</b>			
Geophysics	J. T. Wilson	9,000.00	
Mineralogy	M. A. Peacock	7,000.00	
Spectrographic Studies	J. E. Hawley	18,000.00	
Geochemistry	H. S. Armstrong	3,000.00	
Wire Rope	O. W. Ellis	17,907.68	
Ferrous Metallurgy	O. W. Ellis	19,261.83	74,169.51
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<b>Forestry</b>			
Woodlot Management	R. O. Earl	1,500.00	
Bacteriology	A. S. West	3,000.00	
Sawmilling Practice	W. G. McIntosh	3,000.00	
Regeneration	R. C. Hosie	4,000.00	
Mycorrhiza	G. H. Duff	900.00	
Wood Chemistry	H. B. Marshall	26,477.14	38,877.14
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<b>Industrial Waste</b>			
Milk Waste Disposal	A. E. Berry	5,426.25	5,426.25
<hr/>			
<b>Industrial Research</b>			
Industrial Research Services	D. F. MacRae	43,144.15	43,144.15
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<b>Soils</b>			
Physiography	L. J. Chapman	19,195.66	19,195.66
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<b>Aerial Survey</b>			
Applied Physics	K. B. Jackson	5,000.00	5,000.00 273,255.4
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## APPENDIX II

### SCHOLARSHIP AWARDS—1948-49

Name	Scholarship University	Award
Alderdice, D. F.	University of Toronto .....	\$ 580.00
Anderson, D. V.	University of Toronto .....	1,000.00
Aszt, K. T.	University of Toronto .....	1,000.00
Austin, D. T.	Queen's University .....	580.00
Baldwin, W. F.	University of Toronto .....	580.00
Balkwill, J. K.	Queen's University .....	580.00
Barron, A. L.	Ontario Agricultural College .....	580.00
Bradley, R. A.	University of North Carolina .....	1,000.00
Brubacher, M. J.	University of Toronto .....	580.00
Bushell, A. G.	University of Toronto .....	580.00
Caldwell, A. G.	Iowa State University .....	580.00
Chapman, J. H.	McGill University .....	580.00
Chown, B. F.	University of Toronto .....	580.00
Clemens, H. P.	Ohio State University .....	1,320.00
Collins, C. B.	McMaster University .....	580.00
Doughty, R. B.	University of Toronto .....	580.00
Dunn, A. F.	University of Toronto .....	1,000.00
Duret, M. F.	Queen's University .....	580.00
Farley, J. W.	University of Toronto .....	1,000.00
Falls, J. B.	University of Toronto .....	580.00
George, J. D.	University of Toronto .....	580.00
Gourley, D. R. H.	University of Toronto .....	580.00
Graham, A. R.	University of Toronto .....	1,000.00
Giray, W. M.	University of Toronto .....	1,320.00
Harrold, J. K.	University of Toronto .....	1,000.00
Harvey, J. D.	Ontario Agricultural College .....	580.00
Hay, D. R.	McGill University .....	580.00
Heimpel, A. M.	Queen's University .....	580.00
Henson, W. R.	Yale University .....	1,000.00
Johnson, A. F.	University of Toronto .....	1,320.00
Johnson, Miss S.	University of Toronto .....	1,000.00
Ketchen, K. S.	University of Toronto .....	580.00
Kavrench, W.	Queen's University .....	580.00
Keslie, W. A. G.	University of Toronto .....	580.00
Killie, A. B.	Rice Institute .....	580.00
Kindsay, J. G.	McMaster University .....	580.00
Kocke, J. L.	University of Toronto .....	1,320.00
McCombie, A.	University of Toronto .....	580.00
McCrimmon, H. R.	University of Toronto .....	1,000.00
McLauchlan, T. A.	University of Toronto .....	580.00
McLennan, D. E.	University of Toronto .....	1,000.00
Messel, H.	St. Andrew's, Scotland .....	580.00
	Travel Grant .....	250.00



Name	Scholarship University	Award
Neal, H. E.	University of Toronto .....	580.00
Neil, D. J.	Queen's University .....	580.00
Newcombe, A. G.	University of Toronto .....	730.00
Nixon, W. C.	Queen's University .....	580.00
Norris, D. K.	University of Toronto .....	580.00
Richards, J. H. B.	University of Toronto .....	580.00
Runnels, O. J. C.	University of Toronto .....	580.00
Shepard, M. P.	University of Toronto .....	580.00
Shindman, B.	University of Toronto .....	580.00
Simkins, J. E.	McMaster University .....	580.00
Sims, R. A.	McMaster University .....	580.00
Slack, H. A.	University of Toronto .....	580.00
Snyder, R. A.	University of Western Ontario .....	580.00
Soanes, S. V.	University of Toronto .....	1,000.00
Standil, S.	Queen's University .....	580.00
Stewart, R. W.	Cambridge University, England .....	1,320.00
Stoicheff, B.	University of Toronto .....	580.00
Tanner, H. C.	University of Toronto .....	580.00
Vasileff, H. D.	University of Toronto .....	580.00
Vogan, E. L.	McGill University .....	580.00
Waterman, H. H.	McMaster University .....	580.00
Watson, H. A.	McGill University .....	580.00
West, D. C.	University of Toronto .....	580.00
Wolfe, R. I.	University of Toronto .....	580.00

## APPENDIX III

### ADVISORY COMMITTEES

#### AERIAL SURVEY RESEARCH

##### Main Committee:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands & Forests
Mr. J. A. Brodie	Ontario Dept. of Lands & Forests
Mr. L. J. Chapman	Ontario Research Foundation
Dr. W. Clark	Eastman Kodak Company
Dr. D. R. Derry	Ventures Limited
Mr. W. J. Fulton	Ontario Department of Highways
Dr. L. E. Howlett	Physics, National Research Council
Mr. M. E. Hurst	Ontario Department of Mines
Mr. W. J. Jackson	Williamson Co. of Canada Ltd.
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Mr. D. N. Kendall	Photographic Survey Co., Ltd.
Mr. S. T. B. Losee	Abitibi Power and Paper Co. Ltd.
Prof. O. J. Marshall	Civil Engineering, University of Toronto
Prof. F. F. Morwick	Soils, Ontario Agricultural College
Prof. J. E. Reid	Electrical Engineering, University of Toronto
Mr. A. H. Richardson	Ontario Department of Planning & Development
Mr. J. R. G. Smyth	Ontario Department of Lands & Forests

Meetings: January 20th, 1949, 39 Queen's Park, Toronto.

##### Executive:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. W. J. Fulton	Ontario Department of Highways
Mr. M. E. Hurst	Ontario Department of Mines
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Mr. D. N. Kendall	Photographic Survey Co. Ltd.
Mr. A. H. Richardson	Ontario Department of Planning & Development

Meetings: November 12th, 1948, 39 Queen's Park, Toronto.

##### Photography:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Department of Lands & Forests
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Mr. D. N. Kendall	Photographic Survey Co. Ltd.

## Photogrametry:

Prof. K. B. Jackson  
(Chairman)  
Mr. K. H. Siddall  
Mr. L. G. Timpson  
Prof. W. M. Treadgold  
Mr. J. G. Wilkenson

Applied Physics, University of Toronto  
Ontario Department of Highways  
Ontario Department of Lands & Forests  
Civil Engineering, University of Toronto  
Photographic Survey Co. Ltd.

## AGRICULTURAL RESEARCH

### Main Committee:

Mr. C. F. Luckham  
(Chairman)  
Mr. Ken Betzner  
Mr. J. Gordon Blair  
Dr. H. D. Branion  
Prof. C. G. E. Downing  
Prof. E. H. Garrard  
Dr. E. S. Hopkins

Mr. Lawrence Kerr  
Prof. R. G. Knox  
Dr. A. L. MacNabb  
Mr. M. H. McCurdy  
Dr. G. P. McRostie  
Dr. K. W. Neatby  
Mr. E. F. Palmer

Mr. A. Pitt  
Mr. F. W. Presant  
Prof. G. N. Ruhnke  
Mr. G. A. Schell  
Mr. J. C. Steckley

Mr. W. G. Toner  
Mr. S. B. Trainer  
Mr. George Wilson  
Mr. S. M. Young

### Norfolk Specialty Farms

Farmer, Waterloo  
Niagara Brand Spray Company Ltd.  
Animal Nutrition, Ontario Agricultural College  
Agricultural Engineering, Ontario Agricultural College  
Bacteriology, Ontario Agricultural College  
Central Experimental Farm, Dominion Dept. of Agriculture

Farmer, Chatham  
Animal Husbandry, Ontario Agricultural College  
Ontario Veterinary College  
Cockshutt Plow Company Limited  
Field Husbandry, Ontario Agricultural College  
Science Service, Dominion Dept. of Agriculture  
Horticultural Experimental Station, Ontario Dept. of Agriculture

Massey-Harris Company, Limited  
Toronto Elevators Limited  
Research, Ontario Agricultural College  
Canada Packers Limited  
Western Ontario Experimental Farm, Ontario Dept. of Agriculture

Charles Yeates & Co. Ltd.  
Silverwood Dairies, Limited  
Fruit Branch, Ontario Dept. of Agriculture  
International Harvester Company of Canada Limited

### Co-Ordinating Committee:

Dr. H. D. Branion  
(Chairman)  
Prof. C. G. E. Downing  
Mr. C. F. Luckham  
Mr. E. F. Palmer

Mr. George Wilson

Animal Nutrition, Ontario Agricultural College  
Agricultural Engineering, Ontario Agricultural College  
Norfolk Specialty Farms  
Horticultural Experiment Station, Ontario Dept. of Agriculture  
Fruit Branch, Ontario Department of Agriculture



Dr. E. S. Hopkins  
(Advisory) Central Experimental Farm, Dominion Department of  
Agriculture  
Dr. K. S. Neatby  
(Advisory) Science Service, Dominion Department of Agriculture

## FISHERIES AND WILDLIFE RESEARCH

### Main Committee:

Prof. J. R. Dymond (Chairman)	Royal Ontario Museum of Zoology
Dr. A. M. Fallis (Secretary)	Parasitology, Ontario Research Foundation
Dr. H. Battle	Zoology and Applied Biology, University of Western Ontario
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen
Dr. C. H. D. Clarke	Ontario Department of Lands & Forests
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. C. D. Fowle	Royal Ontario Museum of Zoology
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Department of Lands & Forests
Prof. F. P. Ide	Zoology, University of Toronto
Dr. L. Hughes	Ontario Tourist Trade Association
Dr. W. H. Johnson	Zoology and Applied Biology, University of Western Ontario
Dr. R. N. Johnston	Ontario Department of Lands & Forests
Dr. C. J. Kerswill	Zoology and Applied Biology, University of Western Ontario
Dr. R. R. Langford	Zoology, University of Toronto
Dr. H. H. MacKay	Ontario Department of Lands & Forests
Dr. K. M. Mayall	Ontario Department of Planning & Development
Dr. W. Austin Peters	Ontario Federation of Anglers and Hunters
Dr. N. W. Radforth	Botany, McMaster University
Dr. Lester L. Snyder	Royal Ontario Museum of Zoology
Dr. A. Emerson Warren	Zoology, McMaster University

Meetings: October 1st, 1948, University of Western Ontario, London; March  
1949, Southern Regional Laboratory, Department of Lands & Forests, Maple.

### Executive:

Prof. J. R. Dymond (Chairman)	Royal Ontario Museum of Zoology
Dr. A. M. Fallis (Secretary)	Parasitology, Ontario Research Foundation
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Department of Lands & Forests
Dr. H. N. Johnston	Ontario Department of Lands & Forests

Meetings: November 17th, 1948, 39 Queen's Park, Toronto; February 15th,  
1949, 39 Queen's Park, Toronto.

### Technical Session, 1948-49:

Dr. F. E. J. Fry (Chairman)	Zoology, University of Toronto
Dr. A. M. Fallis	Parasitology, Ontario Research Foundation
Dr. C. David Fowle	Royal Ontario Museum of Zoology
Dr. A. B. James	Toronto East General and Orthopaedic Hospital
Dr. A. Emerson Warren	Zoology, McMaster University
Meetings: March 5th, 1949, Southern Regional Laboratory, Department of Lands & Forests, Maple.	

### Great Lakes Fisheries Research:

Mr. R. N. Johnston (Chairman)	Ontario Department of Lands & Forests
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen
Prof. J. E. Dymond	Royal Ontario Museum of Zoology
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Department of Lands & Forests
Meetings: October 23rd, 1948, Room 103, Biological Building, University Toronto.	

### Wildlife:

Dr. C. David Fowle (Chairman)	Royal Ontario Museum of Zoology
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. C. J. Kerswill	Zoology and Applied Biology, University of Western Ontario
Dr. A. E. Warren	Zoology, McMaster University
Meetings: (Preliminary) February 26th, 1949, 39 Queen's Park, Toronto.	

## FORESTRY RESEARCH

### Main Committee:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Department of Planning & Development
Dr. John E. Bier	Dominion Laboratory of Forest Pathology
Mr. G. G. Cosens	Kimberley-Clark Corporation Limited
Mr. W. A. Delahey	Consulting Forester
Dr. G. H. Duff	Botany, University of Toronto
Mr. T. L. Dunbar	Consultant, Forest Utilization
Prof. R. O. Earl	Biology, Queen's University
Mr. D. A. Gillies	Gillies Bros. & Co. Ltd.
Mr. J. H. Godden	Great Lakes Paper Company
Dr. O. Holden	The Hydro-Electric Power Commission of Ontario
Prof. R. C. Hosie	Forestry, University of Toronto

Mr. R. N. Johnston	Ontario Department of Lands & Forests
Maj. Gen. H. Kennedy	Consulting Engineer
Mr. A. Koroleff	Pulp and Paper Research Institute of Canada
Mr. W. J. LeClair	Canadian Lumbermen's Association
Dr. G. A. Ledingham (Associate)	National Research Council Regional Laboratory, Saskatoon
Mr. A. F. Leslie	Ontario Department of Lands & Forests
Mr. D. A. Macdonald	Dominion Forest Service
Mr. J. B. Matthews	Abitibi Power and Paper Company Ltd.
Mr. T. A. McElhanney	Forest Products Laboratories
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Mr. C. R. Mills	Ontario Forest Industries Association
Dr. M. L. Prebble	Forest Insect Laboratory
Mr. K. O. Roos	Booth Lumber Limited
Mr. S. J. Staniforth	Staniforth Lumber Co. Limited
Mr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited

Meetings: August 30th-September, 1st, 1948, Petawawa Forest Experiment Station.

#### Executive:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Department of Planning & Development
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Mr. J. B. Matthews	Abitibi Power and Paper Company Ltd.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto

Meetings: May 11th, 1948, 39 Queen's Park, Toronto; September 21st, 1948, 39 Queen's Park, Toronto; November 19th, 1948, 39 Queen's Park, Toronto; March 28th, 1949, 39 Queen's Park, Toronto.

#### Wood Chemistry:

Dr. H. B. Marshall (Chairman)	Ontario Research Foundation
Dr. G. A. Adams	Applied Biology, National Research Council
Dr. F. Bender	Forest Products Laboratory
Dr. G. A. Ledingham	National Research Council Regional Laboratory, Saskatoon
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Dr. C. H. Tomlinson, II	Howard Smith Paper Mills Limited

Meetings: August 29th, 1948, Petawawa Experiment Station.

#### Forest Biology:

Mr. A. P. Leslie (Chairman)	Ontario Department of Lands & Forests
Mr. A. B. Baird	Science Service, Dominion Department of Agriculture



Mr. G. G. Cosens	Kimberley-Clark Corporation Limited
Mr. W. A. Delahey	Great Lakes Paper Co.
Dr. G. H. Duff	Botany, University of Toronto
Prof. R. O. Earl	Biology, Queen's University
Prof. R. C. Hosie	Forestry, University of Toronto
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Maj. Gen. H. Kennedy	Consulting Engineer
Mr. D. A. Macdonald	Dominion Forest Service
Mr. C. R. Mills	Ontario Forest Industries Association
Mr. K. O. Roos	Booth Lumber Limited
Prof. J. W. B. Sisam	Forestry, University of Toronto
Mr. W. E. Wilson	Abitibi Power and Paper Company Ltd.

Meetings: June 8th, 1948, 39 Queen's Park, Toronto.

### Sawmilling Practice:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall	Ontario Research Foundation
Mr. W. J. LeClair	Canadian Lumbermen's Association
Mr. T. A. McElhanney	Forest Products Laboratories
Mr. K. O. Roos	Booth Lumber Limited
Mr. J. F. Sharpe	Ontario Department of Lands & Forests
Mr. S. J. Staniforth	Staniforth Lumber Co. Limited

## HIGHWAYS RESEARCH

### Main Committee:

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association
Mr. H. N. Lamont (Secretary)	Ontario Department of Highways
Mr. T. N. Carter	Carter Construction Co. Ltd.
Mr. L. J. Chapman	Ontario Research Foundation
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	District Engineer, Toronto
Mr. W. B. Hastings	Ontario Motor League
Mr. A. K. Hay	Federal District Commission
Prof. H. A. Low	Civil Engineering, Queen's University
Mr. J. A. P. Marshall	Ontario Department of Highways
Dr. N. W. McLeod	Imperial Oil Limited
Mr. W. J. Moore	Ontario Municipal Board
Mr. C. A. Robbins	Ontario Department of Highways
Mr. D. O. Robinson	Canada Cement Co.
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. Walter	Ontario Department of Highways
Mr. R. B. Young	Ontario Hydro-Electric Commission
Mr. V. H. Evans (Ex Officio)	Ontario Good Roads Association

Mr. D. O. Johnson  
(Ex Officio)

Ontario Roadbuilders' Association

Meetings: May 20th-21st, 1948, Board Room, Department of Highways and  
Soils Laboratory, Department of Highways, Toronto.

### Organization:

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association
Mr. H. W. Lamont (Secretary)	Ontario Department of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	District Engineer, Toronto
Prof. R. A. Low	Civil Engineering, Queen's University
Mr. N. McLeod	Imperial Oil Limited
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. Walter	Ontario Department of Highways

Meetings: April 3rd, 1948, 39 Queen's Park, Toronto; April 16th, 1948, 39  
Queen's Park, Toronto; June 14th, 1948, 39 Queen's Park, Toronto; November  
th, 1948, 39 Queen's Park, Toronto; January 29th, 1949, 39 Queen's Park,  
Toronto; February 21st, 1949, 39 Queen's Park, Toronto; March 11th, 1949, 39  
Queen's Park, Toronto.

### Materials and Construction:

Mr. T. F. Francis (Chairman)	District Engineer, Toronto
Mr. C. Fraser	Division Engineer, Owen Sound
Mr. T. Johnston	Ontario Department of Highways
Mr. E. W. Jones	County Engineer, Barrie
Mr. T. R. Patterson	County Engineer, Goderich
Prof. W. L. Sagar	Civil Engineering, University of Toronto

### Planning, Economics and Administration:

Prof. R. A. Low (Chairman)	Civil Engineering, Queen's University
Mr. A. E. K. Bunnell	Ontario Department of Planning & Development
Mr. W. A. Clarke	Division Engineer, Kingston
Mr. W. J. Fulton	Ontario Department of Highways
Mr. J. M. MacInnes	Ontario Department of Highways
Mr. G. R. Marston	County Engineer, Simcoe
Mr. J. L. Zoller	Ontario Department of Highways

Meetings: March 25th, 1949, 39 Queen's Park, Toronto.

### Design:

Mr. D. J. Emrey (Chairman)	County Engineer, Kitchener
Mr. T. F. Francis	District Engineer, Toronto
Mr. R. M. Lee	County Engineer, Brantford
Mr. N. W. McLeod	Imperial Oil Limited

Mr. D. G. Ramsay	Division Engineer, Toronto
Mr. D. O. Robinson	Canada Cement Co.
Mr. J. Walter	Ontario Department of Highways

Meetings: March 25th, 1949, 39 Queen's Park, Toronto.

### Soils and Foundation:

Mr. J. Walter (Chairman)	Ontario Department of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Prof. R. A. Low	Civil Engineering, Queen's University
Mr. A. D. McGinnis	McGinnis and O'Connor
Dr. N. W. McLeod	Imperial Oil Limited
Mr. D. G. Watt	Ontario Hydro-Electric Power Commission

## INDUSTRIAL RESEARCH

### Main Committee:

Mr. C. A. Pollock (Chairman)	Dominion Electrohome Industries, Ltd.
Mr. H. L. Bemis	Campbell Soup Company Ltd.
Mr. G. C. Bernard	Canadian Manufacturers' Association Inc.
Mr. Lorne S. Campbell	Ontario Department of Planning & Development
Mr. Howard Chamberlain	Lowe Brothers Co. Ltd.
Mr. T. A. Faust	Yocum Faust, Limited
Col. F. J. Lyle	Ontario Department of Planning & Development
Col. D. F. MacRae	Ontario Industrial Research Services
Dr. H. B. Speakman	Ontario Research Foundation
Mr. D. B. Strudley	Imperial Rattan Co. Limited
Mr. A. B. Ward	Ontario Research Foundation

N.B.—Until his death in February, 1949, Mr. E. T. Sterne, Manager, G. Sterne & Sons Limited, was Chairman of this Committee.

Meetings: May 25th, 1948, 39 Queen's Park, Toronto; June 29th, 1948, Queen's Park, Toronto; September 13th, 1948; 39 Queen's Park, Toronto; November 17th, 1948; 39 Queen's Park, Toronto; January 19th, 1949, 39 Queen's Park, Toronto.

## INDUSTRIAL WASTE RESEARCH

### Main Committee:

Dr. A. E. Berry	Ontario Department of Health
Mr. G. A. H. Burn	Ontario Department of Health
Mr. A. V. DeLaporte	Ontario Department of Health
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Prof. A. C. Plewes	Chemical Engineering, Queen's University
Dr. H. B. Speakman	Ontario Research Foundation

N.B.—Until his death in February, 1949, Mr. E. T. Sterne, Manager, G. Sterne & Sons Limited, was Chairman of this Committee.

Meetings: June 2nd, 1948, 39 Queen's Park, Toronto; December 29th, 1948, 39 Queen's Park, Toronto; March 9th, 1949, 39 Queen's Park, Toronto.



# MINES, MINERALS AND METALLURGY RESEARCH

## Main Committee:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Prof. H. S. Armstrong	Geology, McMaster University
Prof. E. L. Bruce	Research Geology, Queen's University
Prof. O. A. Carson	Metallurgy, Queen's University
Dr. O. W. Ellis	Ontario Research Foundation
Dr. C. S. Evans	Union Gas Company of Canada, Ltd.
Dr. G. S. Farnham	The International Nickel Company of Canada, Ltd.
Dr. D. L. H. Forbes	The Teck-Hughes Gold Mines, Ltd.
Mr. T. W. Hardy	Climax Molybdenum Company
Prof. J. E. Hawley	Mineralogy, Queen's University
Prof. L. M. Pidgeon	Metallurgical Engineering, University of Toronto
Prof. G. H. Reavely	Geology and Geography, University of Western Ontario
Mr. H. C. Rickaby	Ontario Department of Mines
Mr. R. H. Rimmer	Aluminium Laboratories Ltd.
Mr. W. Samuel	Steep Rock Iron Mines Ltd.
Mr. G. M. Thomson	General Engineering Company of Canada
Mr. W. B. Timm	Dominion Department of Mines & Resources
Dr. C. R. Whittemore	Deloro Smelting & Refining Co. Ltd.
Dr. G. E. Willey	Algoma Steel Corporation, Ltd.
Prof. C. G. Williams	Mining Engineering, University of Toronto
Prof. J. T. Wilson	Physics, University of Toronto
Mr. R. B. Young	Hydro-Electric Power Commission of Ontario

Meetings: October 8th, 1948, Ontario Research Foundation, 47 Queen's Park, Toronto.

Meetings: January 26th, 1949, 39 Queen's Park, Toronto.

## Executive:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Mr. O. W. Ellis	Ontario Research Foundation
Mr. H. C. Rickaby	Ontario Department of Mines
Prof. C. G. Williams	Mining Engineering, University of Toronto
Mr. R. B. Young	Hydro-Electric Power Commission of Ontario

Meetings: October 7th, 1948, Ontario Research Foundation, 43 Queen's Park, Toronto; November 24th, 1948, 39 Queen's Park, Toronto.

## Non-Ferrous Metallurgy:

Mr. O. W. Ellis (Chairman)	Ontario Research Foundation
Mr. P. E. Cavanagh (Secretary)	Ontario Research Foundation
Mr. T. W. Hardy	Climax Molybdenum Company
Mr. F. A. Loosley	Dominion Foundries and Steel Ltd.

Mr. R. J. Traill  
Mr. W. Samuel  
Mr. D. G. Watt  
Dr. G. E. Willey  
Mr. R. B. Young

Dominion Department of Mines and Resources  
Steep Rock Iron Mines Ltd.  
Hydro-Electric Power Commission of Ontario  
Algoma Steel Corporation Ltd.  
Hydro-Electric Power Commission of Ontario

Meetings: April 22nd, 1948, Ontario Research Foundation, 43 Queen's Park  
Toronto; September 8th, 1948, Ontario Research Foundation, 43 Queen's Park  
Toronto.

### Non-Ferrous Metallurgy:

Dr. C. R. Whittemore  
(Chairman)  
Dr. O. W. Ellis  
Dr. G. S. Farnham  
Mr. W. M. Goodwin  
Mr. L. J. Lichty  
Dr. L. M. Pidgeon  
Mr. M. J. Tamplin

Deloro Smelting & Refining Co. Ltd.  
  
Ontario Research Foundation  
International Nickel Co. of Canada, Ltd.  
Bureau of Mines  
Ventures, Ltd.  
Metallurgical Engineering, University of Toronto  
Falconbridge Nickel Mines

### Wire Rope:

Dr. O. W. Ellis  
(Chairman)  
Mr. I. A. Usher  
(Secretary)  
Mr. N. B. Brown  
Mr. R. E. Dye  
Mr. R. L. Healy  
Mr. A. C. Halferdahl  
Mr. W. E. Brown  
Mr. J. G. Morrow  
Mr. R. D. Parker  
Mr. N. F. Parkinson  
Mr. R. S. Segsworth  
Mr. D. G. Sinclair  
Mr. L. W. Sproule  
Mr. R. B. Young

Ontario Research Foundation  
  
Ontario Research Foundation  
  
Bureau of Mines  
Dome Mines, Ltd.  
Wright-Hargreaves Mines Ltd.  
National Research Council  
B. Greening Wire Co. Ltd.  
Steel Company of Canada Ltd.  
International Nickel Co. of Canada, Ltd.  
Ontario Mining Association  
General Engineering Co. (Canada) Ltd.  
Ontario Department of Mines  
Imperial Oil Limited  
Hydro-Electric Power Commission of Ontario

Meetings: January 19, 1949, Ontario Research Foundation, 43 Queen's Park  
Toronto.

### Geology:

Dr. E. L. Bruce  
(Chairman)  
Mr. J. O. Gorman  
Dr. J. E. Hawley  
Mr. M. E. Hurst  
Dr. G. B. Langford

Geology, Queen's University  
  
Hydro-Electric Power Commission of Ontario  
Mineralogy, Queen's University  
Ontario Department of Mines  
Geological Sciences, University of Toronto

Dr. H. S. Scott                      Physics, McMaster University  
 Mr. G. M. Thomson                General Engineering Co. (Canada) Limited  
 Meetings: December 28th, 29th, 1948, Kingston.

## OILS RESEARCH

### Main Committee:

Dr. H. B. Speakman (Chairman)	Ontario Research Foundation
Mr. L. J. Chapman (Secretary)	Ontario Research Foundation
Prof. E. H. Garrard	Bacteriology, Ontario Agricultural College
Mr. G. A. Hills	Ontario Department of Lands & Forests
Mr. R. N. Johnston	Ontario Department of Lands & Forests
Mr. A. Leahey	Central Experimental Farm, Ottawa
Prof. F. F. Mordick	Chemistry, Ontario Agricultural College
Mr. E. F. Palmer	Horticultural Experiment Station, Vineland
Prof. F. L. Peckover	National Research Council
Prof. D. F. Putnam	Geography, University of Toronto
Mr. A. H. Richardson	Ontario Department of Planning and Development
Prof. G. N. Ruhnke	Research, Ontario Agricultural College
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. W. B. Sisam	Forestry, University of Toronto
Mr. J. Walter	Ontario Department of Highways

Meetings: July 5th, 1948, 39 Queen's Park, Toronto; September 27th, 1948, Queen's Park, Toronto.





**RESEARCH COUNCIL OF ONTARIO**

**Annual Report - 1950**





# RESEARCH COUNCIL OF ONTARIO

## *Second Annual Report*

1949 - 1950



ONTARIO

TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

DEPARTMENT OF PLANNING & DEVELOPMENT

May 31st, 1950.

TO THE HONOURABLE RAY LAWSON, O.B.E.,  
Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour the  
Annual Report of the Research Council of Ontario for the year ended  
March 31st, 1950.

Respectfully submitted.

WILLIAM GRIESINGER,

Minister

Research Council of Ontario,  
39 Queen's Park Cres.,  
Toronto 5, Ont.

May 31st, 1950.

The Honourable William Griesinger,  
Minister of Planning & Development.

Sir:

There is submitted herewith the report of the Research Council of Ontario for the year 1949-50. It consists of the Director's summary of the work of the year, the report of the Chairmen of the Advisory Committees, the list of the personnel of the various committees which have been active during the year, and the financial statement. As the report shows, the activities of the Council have been directed to stimulating research in fields which have a direct bearing on development in the Province, and in advising the Government as to the most fruitful use of public funds to that end.

It has been the policy of the Council to work in the closest co-operation with the Ontario Research Foundation, and with the universities of the Province. The Council does not of itself carry on research. The Foundation and the universities are the active organizations to which special projects can be assigned. This is mutually helpful. Industrialists and research scientists meet to discuss the problems, and in doing so learn to understand the viewpoints of industry and of research. Close contact is also kept with the departments of the Government, in order that administrative problems which need the aid of research can be dealt with on a co-operative basis. A very encouraging aspect of the whole situation is the indication that certain industries are prepared to co-operate, with the help of a Government grant, in financing research in problems of common interest and importance. In time such group research activities will become a very important aspect of industrial research.

On the request of the Government, a Committee with Dr. R. K. Stratford as Chairman is investigating the situation in the Spanish River at Espanola in order to advise as to the steps which should be taken to counteract any deleterious foreign material which the pulp mill situated on the river may have introduced into the river. It is probable that the findings of the Committee may be of value in other similar situations in the Province of Ontario.

The members of the Research Council of Ontario are grateful for the active interest which our Minister has taken in the work of the Council. The members of the Government, and in particular the Premier, have also given



of their time and support to the Council in its activities. There is need for more money to be spent on research in Ontario if industry is to take, and maintain, its rightful place in the Province. The members of the Council see the need. They have the responsibility of presenting that need to the Government, and through the Government, to the people of Ontario.

It remains to express appreciation of the work of the Director. His energy and his enthusiasm mean very much.

Respectfully submitted,

ROBT. C. WALLACE,

President

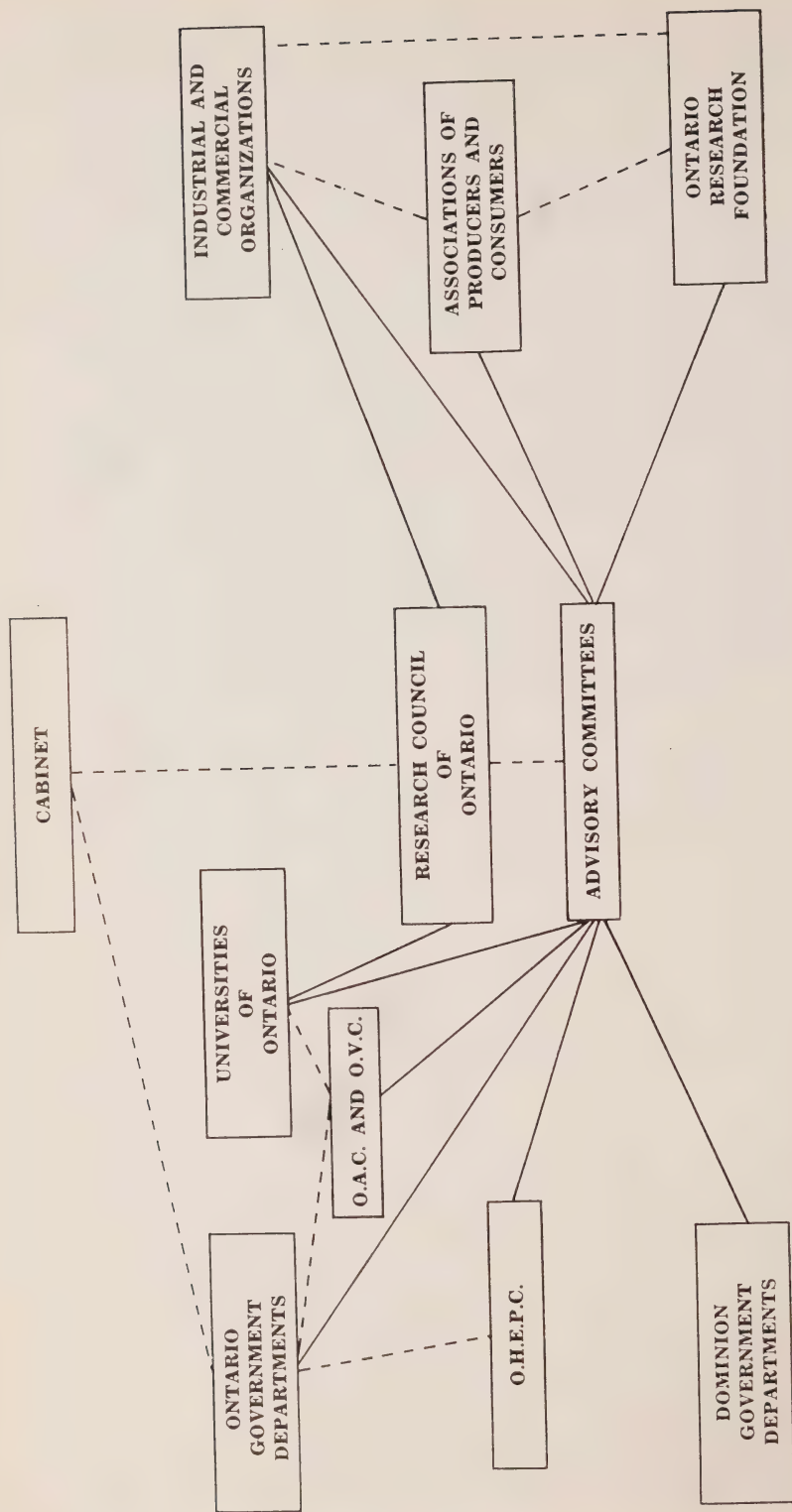


# RESEARCH COUNCIL OF ONTARIO

Visiting the University of Western Ontario, London, Ont.

Back row, left to right—Hugh Lawson, J. O. Wilhelm, Sidney E. Smith, H. B. Speakman, C. R. Young.  
Front row, left to right—G. P. Gilmour, Robt. C. Wallace, G. E. Hall, R. K. Stratford, E. Holt Gurney, G. N. Ruhnke.

PHOTO: COURTESY THE LONDON FREE PRESS



RESEARCH CO-ORDINATION IN ONTARIO



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## RESEARCH COUNCIL OF ONTARIO

		Term
Dr. R. C. Wallace ----- (President)	Principal, Queen's University, Kingston.	1953
Dr. R. K. Stratford ----- (Vice-President)	Research Director, Imperial Oil Limited, Sarnia.	1952
Dr. G. P. Gilmour -----	Chancellor and President, McMaster University, Hamilton.	1951
Dr. E. Holt Gurney -----	Chairman of the Board, Gurney Industries Ltd.	1953
Dr. G. E. Hall -----	President, University of Western Ontario, London.	1951
Mr. Hugh Lawson -----	Vice-President and Director, York Knitting Mills, Limited, Toronto.	1951
Col. W. E. Phillips -----	1200 Bay St., Toronto	1953
Prof. G. N. Ruhnke -----	Director of Research, Ontario Dept. of Agriculture, Guelph.	1953
Dr. Sidney E. Smith ....	President, University of Toronto, Toronto.	1952
Mr. H. M. Turner -----	President, Canadian General Electric Co. Ltd., Toronto.	1952
Dr. C. R. Young -----	72 Roxborough Dr., Toronto	1951
<b>Director</b>		
J. O. Wilhelm -----	Research Council of Ontario, Toronto.	

### Meetings:

April 20th, 1949, 39 Queen's Park, Toronto.  
 Nov. 20th-21st, 1949, General Brock Hotel, Niagara Falls.  
 March 1st, 1950, Royal York Hotel, Toronto.

### Executive

Dr. R. C. Wallace (President)	Principal, Queen's University, Kingston.
Dr. R. K. Stratford (Vice-President)	Research Director, Imperial Oil Limited, Sarnia.
Dr. E. Holt Gurney	Chairman of the Board, Gurney Industries Ltd., Toronto.

- Dr. G. E. Hall ..... President, University of Western Ontario,  
London.
- Dr. C. R. Young ..... 72 Roxborough Dr., Toronto.

#### Meetings:

September 1st, 1949, 39 Queen's Park, Toronto.

#### Scholarship Committee

- Dr. R. C. Wallace ..... Principal, Queen's University, Kingston.  
(President)
- Dr. E. Holt Gurney ..... Chairman of the Board, Gurney Industries  
Ltd., Toronto.
- Dr. G. E. Hall ..... President, University of Western Ontario,  
London.
- Dr. G. P. Gilmour ..... Chancellor and President, McMaster  
University, Hamilton.
- Prof. G. N. Ruhnke ..... Director of Research, Ontario Department  
of Agriculture, Guelph.
- Dr. Sidney E. Smith ..... President, University of Toronto, Toronto.
- Dr. C. Young ..... 72 Roxborough Dr., Toronto.

#### Meetings:

February 28th, 1950, Royal York Hotel, Toronto.





## DIRECTOR'S REPORT

The second year of operation of the Research Council of Ontario has been an active one and many of the projects and policies initiated by the Ontario Research Commission are taking concrete form. The final report of the Commission envisaged many activities that would be necessary in the development of a co-ordinated research program within the Province. Some of these have begun and others are being surveyed and discussed.

During the year the Director has had the fullest co-operation from all the members of the Council and the members of the various advisory committees. Within the various departments of Government, both Provincial and Dominion, the heartiest co-operation has been received. Many organizations, such as the Canadian Manufacturers' Association, Canadian Lumbermen's Association, Canadian Society of Forest Engineers, Canadian Forestry Association, Ontario Forestry Industries Association, Ontario Mining Association, Ontario Good Roads Association, and others, have co-operated by suggesting representatives for committees and in many other ways.

Research in the sciences related to the use of the natural resources of the Province has grown in a rather spasmodic fashion. This is evident from the reports of the advisory committees. Some universities have departments with well developed research teams. Some Government departments have recognized research by setting up research divisions. Some of the industries co-operating with the Government established the Ontario Research Foundation in 1927 and several of the industries in Ontario have large research departments within the organization. Although in a few cases research has resulted from an emergency, in nearly every case the development has been the result of the interest of one or two individuals. Realizing that the stimulation of interest in research is the best way of ensuring that research will be of benefit, the Research Council in its activities has attempted to give assistance where interest has been shown.

The philosophy which prompted the exhortation "in the sweat of our brow shall ye eat bread" is sound today, and support has been given to those who, in addition to giving lip service to the organization of research, have shown by example that they are capable of doing good work.

### Group Research

The idea of group research has been given special attention and this year two projects are under way. The first is the problem of production of sponge iron using a production style of brick kiln. This project will cost \$40,000. Four of the steel companies have contributed \$5,000 each which provides \$20,000 toward the cost of the project. The Provincial Government through the Research Council of Ontario is providing the other half of the funds. Co-operation has also been received from many other groups who have offered their facilities, sometimes at considerable

personal inconvenience. The technical direction of the project is under a sub-committee of the Research Council. The second problem involves spoilage in canned vegetables. Five canning companies are co-operating. They have contributed \$5,500 and the Provincial Government has given the same amount toward the project.

In both cases mentioned here, the results are being written up and prepared for general circulation for the benefit of any who may find them of use.

Other group projects are under discussion and an organizational mechanism is gradually developing that will permit of the soundest kind of co-operation in the development of research between industry and the Government. The exact detail in each case is not always evident at the beginning but experience so far indicates that approached with the proper spirit and based on the best information the organizational detail is a relatively minor element.

The Director has had an opportunity for discussing the guiding interest back of the group research idea with a number of organizations during the past year. Many people within the Province and in other provinces are very much interested and the working out of group research projects under the Council is being watched with some interest.

### **Ontario Research Foundation**

The liaison with the Ontario Research Foundation has been maintained as closely as possible. Occupancy of the same buildings and cross representation on many committees makes the contact between the Council and the Foundation so close that there is some difficulty, on the part of the general public, to differentiate between the two. From the point of view of the Director this is a healthy state.

Several of the Council projects are conducted by the Ontario Research Foundation. These are discussed in greater detail under Committee Report and for the year totalled \$184,214.06. The direction in which this work will develop will be observed with interest and is closely related to the group research idea, since initially the Ontario Research Foundation was set up from funds which were provided by industry and the Provincial Government on an equal basis.

### **Universities**

The universities continue to be the main source for fundamental research. Grants totalling \$65,500 have been made to individual scientists within the universities during the 1949-1950 fiscal year. The list of publications given later in the report indicates some of the work that has resulted where funds of the Council have been spent.

Membership on the various committees from the staffs of the universities provides a corps of objective scientific men and women who give not only sound factual advice but serve as a liaison between the Council and the supply of research students that are coming up through the university courses.

### Scholarships

The scholarship plan has been active during the year and 58 scholarship students this year conducted work in 10 different universities; 39 working in Ontario universities, 5 were working in other Canadian universities, 12 were working in the United States and 2 were working abroad. The scholarship plan is taking quite definite shape and it is being closely co-ordinated with the scholarship activity of the National Research Council. The Director has also had discussions with a number of other agencies that are interested in the provision of scholarship in specific fields. The scholarships effort at the provincial level is meeting a valuable need.

During the month of January the Director visited the Ontario universities and discussed with the senior students the basis on which the Research Council scholarships are given and in addition the same material was presented to some of the members of the staff. In this way students and staff are becoming acquainted with the scholarship plan of the Council.

### Committees

The work of the advisory committees has gone forward smoothly during the year. Some committees are more active than others, but this to a certain extent is related to the appreciation of the value of research in the various fields. In the case of some of our natural resources, abundance and easy access have given little need to apply research. This is no longer the case, and most groups are beginning to take an active interest in the accumulation of fundamental knowledge through research.

The activity of the various committees is outlined in the individual Committee Reports which have been prepared by the committee chairmen. The length of the report however is not a true indication of the activity of the committee. In some committees specific ideas have been under active development. It was felt that as particular ideas are worked out a fuller discussion of these new suggestions should each year form a part of the or other committee report. It is hoped that this will prove helpful not only to members of the particular committee but to other committees that may be able to apply the same line of thought to their activities. Even a casual reading of the committee reports indicates the extent to which, by their discussions and by their meetings in various points in the Province, the committees are serving to stimulate the development of research and wider application.



The Forestry Committee has been studying many problems, but one in particular may be mentioned as an illustration of what is being done. The Forest Products Laboratory and the Research Council of Ontario have been investigating the waste produced in the primary breakdown of logs in the production of lumber. The machinery and practices in the Province are much the same as they were fifty years ago despite marked improvements in metallurgy and practice. It has been estimated that if the width of the cut taken from a log by a saw as a board or cant is sawn were reduced by 1% on the saws in Canada an annual saving of 10 million board feet of lumber would result. A sub-committee is directing a program of work that is described in some detail in Dean J. W. B. Sisam's report of the Forestry Committee.

A program of study is in hand to determine something more definite about the production of fish in Lake Erie. This is being directed largely from the Department of Biology at the University of Western Ontario, with general assistance from the various groups who are represented on the Advisory Committee of Fisheries and Wildlife. The early work on Lake Erie was mainly exploratory. This year the program is being extended and will be more actively pursued now that the significant factors are somewhat clearer. The work is centered at Erieau and the fishermen on Lake Erie have been very helpful with advice and assistance.

Agriculture has the longest history of research, extension and education. The Dominion and Provincial departments have the most highly developed organization for the co-ordination of their work. Biological and forestry research are in general just beginning though some phases have been well developed. In the highways field practically no research is being carried out in the engineering departments of the universities in Ontario. Engineers employed in the direction and execution of the highways programs are, by their training, for the most part not brought into contact with the benefits to be derived from research except as they see it applied in Britain, the U.S.A. and to an extent in the other provinces.

### Director's Activities

Contact has been maintained with many of the professional groups through attendance at meetings and by acting on various committees.

With the assistance of the chairmen and secretaries of the various advisory committees, the meetings of these committees have been carried out and the committees' activities have been recorded and circulated. The Director has made an attempt to attend all of the meetings of the advisory committees and sub-committees as well as the Council meetings and Executive meetings of the Council.

The Director has accompanied various members of the Government departments, university research workers and others on visits throughout



the Province in order to maintain an active contact with the work being undertaken in the universities and in the field. He has taken part in the activities of scientific societies and has addressed many groups.

## ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE

Chairman: Prof. J. R. Dymond

Secretary: Dr. A. M. Fallis

Organizations carrying out fisheries and wildlife research in Ontario include four universities (Toronto, Queen's, McMaster, Western Ontario), Ontario Research Foundation, Royal Ontario Museum of Zoology, Ontario Veterinary College, Department of Lands and Forests and Department of Planning and Development.

The information resulting from these researches ranges from that which is immediately applicable to practical problems of management, through some which must await the acquisition of additional knowledge to some which may never be of any practical value. The acquisition of new knowledge is only part of the value of research. An important part is the training of future research personnel. Much of the research in universities by students working for advanced degrees is carried out under direction of experienced research workers.

The nature of much fisheries and wildlife research has changed greatly in recent years. The changes have been largely due to the need for information to apply in management and the knowledge needed for fisheries and wildlife management is costly in facilities, personnel and time.

In the early days of fisheries research, studies were largely confined to investigating the growth and food habits of fish. All that was needed were a few scales and the stomach of a fish. These could usually be got from fishermen for nothing. To read the age from the scales only a microscope was needed. Later when the basic food supply of the waters began to be investigated boats for the collection of samples by hauling plankton nets through various strata of the water or dredging up samples of the bottom were necessary. At first the limnologist had to be content to go with a fisherman or to acquire a small boat which he could use where and when he wished. Additional equipment, but still relatively inexpensive, was required.

When as a basis for management it is necessary to know with some accuracy the size of fish populations, to trace their movements and to determine the effect of fishing on them, it becomes necessary to operate fishing boats and fishing gear and to handle thousands or even hundreds of thousands of fish if population estimates are to be sufficiently reliable to be of any value for management.

Comparable changes have occurred in wildlife research. To study population changes using such animals as mice as research materials, it was possible to get data on a sufficient number of animals by trapping a few acres by traps costing a few cents each. To get information on the same number of moose or deer or even beavers or muskrats it is necessary to cover a great deal of territory and to use much more expensive equipment including even aircraft.

The cost of investigating deer populations is probably as much greater than the cost of investigating a mouse as the deer is bigger than the mouse. Support of wildlife research hasn't got much beyond the mouse stage; it may possibly be in the squirrel stage. Some research is being done on muskrats, beaver and deer but it is quite inadequate to give the information necessary for management.

Time is another element in fisheries and wildlife research. Observations over many years are necessary before it is safe to draw conclusions. In the physical sciences experiments in the laboratory can be carried out in which all conditions are kept constant except the one whose effect is being studied. Experiments of this type are impossible when the factors affecting populations are being investigated. Many factors — food, space, predators, parasites, disease, humidity, temperature, light, etc. are continually changing. In effect nature is carrying out experiments but instead of keeping all factors except one constant, she is continually varying them all. The biologist must make a record of all of the different conditions obtaining at any one time including the size of the population and repeat this enough times so that he has observations under many combinations and permutations of conditions before he can safely draw conclusions as to the effect of each factor in producing the observed result. This takes time as well as adequate personnel, equipment and facilities. The estimation of only one factor, namely the size of animal populations in itself is a formidable problem.

The Committee has taken an interest in the research work being done in parasitology in the Ontario Research Foundation. The work is partially supported through grants recommended by the Committee.

The problems in this highly specialized field have some very practical applications. The incidence and control of "swimmer's itch" is related to the life cycle of one of the parasites. Another parasite is suspected of being the cause of heavy mortality in the beaver colonies. In co-operation with the Ontario Department of Lands and Forests some 250 animals and birds were examined. Parasitic infection when present was removed and preserved for identification.

The cost of basic research in fisheries and wildlife has also greatly increased. To measure the factors determining the productivity of or

body of water as compared with another requires chemical analyses of all the numerous nutrients in the water and measurements of the penetration of light as well as the estimation of the size of the populations of fish produced. This information is necessary not only to understand the reason for differences in productivity between waters but also in investigating means for enriching waters through fertilization. As we advance further into the unknown, the cost of all types of research increases.

Investigation of some of the problems involved in fisheries and wildlife management requires not only greatly increased financial support but may also involve the creation of a new type of research organization. Obviously, research involving the accumulation of observations on the size of populations and the attendant biotic and meteorological conditions over a long period of years is beyond the scope or resources of a University Department.

Ecology, the branch of the biological sciences that deals with the habits and modes of life of plants and animals in relation to their surroundings, has come to the front rather recently. It is suggested that an organization such as Ecological Institute once proposed by this Committee would be more likely to provide the continuity and the combination of academic and applied direction needed for this type of long term research. Such an institute would have to be supported by government funds but its direction might best be in the hands of a Board on which universities, administrative departments of government and the industries concerned should all have representation.

Since many of the problems involved in the administration of our fish and wildlife resources are common to several provinces some sort of co-operation between the provinces is advisable in the interest of economy. Is each province having moose, deer, beaver and muskrats to carry out research on these animals? Obviously they are not all going to do research on all species of fish and wildlife. In the interest of efficiency and economy regional fisheries and wildlife research institutions should be set up in a number of centres across the country financed and administered under some sort of co-operative arrangement among the provinces. To assure the success of such an arrangement some sort of participation by the Federal Government is believed to be essential.

## Reports

Final Report, Rodent Repellent Studies (L. A. O. Roadhouse), R.C.O. Report 3-3-49.

Progress Report, Fisheries and Wildlife Projects, 1949-50, R.C.O. Report 3-4-50.

Abstracts of Papers Presented at the Fourth Technical Session, Advisory Committee on Fisheries and Wildlife Research, February 24-25, 1950.

# ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Dean J. W. B. Sisam

Secretary: Dr. H. B. Marshall

## Introduction

The Advisory Committee on Forestry held two meetings during the past year, the first one on May 1st-2nd at Port Arthur, and the second through the kind invitation of one of its members, Mr. D. A. Gillies, at his home near Arnprior on October 5th-6th.

One feature of this Committee that is unique among forestry groups and at the same time is a definite advantage is the fact that it includes representatives from both the forest production and wood utilization groups. This not only adds to the overall effectiveness of the Committee but provides the members, representing as they do all aspects of forestry from both government and industrial groups, an opportunity to discuss among themselves many problems of common interest.

In general the two problems that have been of greatest concern to the Committee during the past year are first the prodigious waste of raw material that is characteristic at the present time of our forest-operating and wood-using industries — this includes absolute waste in the forest and the mill and also waste due to the improper use of various kinds and sizes of material. The second main problem is one of direct importance to forest production — the adequate regeneration of our most important timber tree species. In addition attention has been given to a number of what one might term subsidiary problems and also to the general question of forestry research organization in the Province of Ontario.

## Wood Utilization

The wood-using industries include two main groups — that which involves chemical utilization, mainly the pulp and paper group, and that which makes use of wood in its natural state, i.e. the lumber, furniture, plywood and other similar industries.

Waste of raw material is a characteristic feature of certain processes both of these groups of industries.

**Chemical Utilization.**—In the manufacture of sulphite pulp approximately 50 per cent. of the wood is discarded as lignin and other organic materials, in the form of waste sulphite liquor, representing a loss of some 15 million lbs. per day of material from Canadian pulp mills. The problem of finding uses for these by-products has been the subject of growing concern for the industry, not only to obtain the maximum commercial value per lb. of wood waste, but, perhaps more urgently, to avoid the unfavourable conditions such as stream pollution that often result from the disposal



this material. Some progress has been made as a result of a great deal of research over the past forty years. The importance of this problem to the industry in Ontario has made it one of chief concern to our Wood Chemistry Sub-Committee. This Sub-Committee has studied various important aspects of the general problem and has prepared reports on this work which were published in the June issue of the Pulp and Paper Magazine of Canada. Following this, Dr. Marshall of the Ontario Research Foundation and Chairman of the Wood Chemistry Sub-Committee prepared a report on the present situation with respect to the utilization of waste sulphite liquor. This report was presented at the main meeting of the Advisory Committee and provides a valuable reference to the subject in concise form.

As with any extensive problem on which research has been carried out over a period of years, there is a gradual accumulation of literature in various forms and languages. As this grows, it becomes necessary for its most efficient use to have a properly organized bibliography and summary of the literature. A review of this sort for the literature on waste sulphite liquor research was made for the period representing the history of the industry from its beginning up to 1943. Increased research activity in this field has resulted in a voluminous literature since that date and on the recommendation of the Wood Chemistry Sub-Committee a further summary to cover the period 1943-49 has been prepared by Dr. Marshall and will be published shortly.

This Sub-Committee also has under its supervision research on four projects that are being studied at the Ontario Research Foundation under the sponsorship of the Research Council. Two of these, which have to do with the general problem referred to above, are: (1) Fundamental investigation into the separation of the constituents of waste sulphite liquor, and (2) The utilization of lignin as a tanning agent. The other two projects are both of a fundamental nature, the first on the chemistry of birch wood, and the second on the essential oils from Ontario trees. The former is, of course, basic to the efficient use of this or any other species in the chemical wood industries, while the latter may make it possible to develop commercial uses for part of the great volume of foliage that is at present completely discarded in all forest operations.

The Sub-Committee has recommended that steps be taken to establish wood chemistry research in the universities of Ontario. The Advisory Committee is giving full support to this recommendation and is pleased to know that some progress is being made towards its implementation. (It may be mentioned here that more than one complaint has been heard from representatives in industry that Ontario is far behind Quebec in such research at this level).

**Sawmilling.**—The conversion of saw-logs to lumber under present methods of manufacture results in about 50 per cent of the original volume

of wood being used in the final product. The other 50 per cent of wood volume is largely wasted, used inefficiently, or occasionally used efficiently in the manufacture of some by-product. One approach to the problem of reducing the amount of waste involved in lumber manufacture would be to increase efficiency in log conversion through improvements in machinery and methods used — e.g. it has been estimated that a decrease in the saw kerf produced by circular saws in this country by one per cent would be equivalent to ten million ft. b.m. of lumber. From a careful study of all available information, it is apparent that there has not been any outstanding advances in sawmilling machinery or in sawmilling technique since the turn of the century. There were, of course, marked developments during the last quarter of the nineteenth century as a result of the pressure of an increasing and continuing demand for lumber at that time. The bandsaw which was introduced during the 1890's and which greatly increased both the efficiency of utilization and the productive capacity of the mills, was the last major development in sawmilling equipment despite the tremendous advances that have been made since then in the metallurgical and mechanical sciences.

In view of the lack of technical development in this field the Advisory Committee in 1947 recommended that a survey be made, from the mechanical engineering point of view, of present day sawmill machinery and equipment in this and other countries in order to learn of any existing design that might be particularly suitable for conditions in this country. This survey has been completed and reports have been prepared, or are in the course of preparation, on designs of small and portable sawmills and on auxiliary equipment such as edgers, trimmers, cut-off saws, etc.

Concurrently with this survey, the Forest Products Laboratory was conducting a study of sawmills in Canada, with particular reference to statistics of production and wood waste. As these two programs have progressed, the closest liaison has been developed and continued between those concerned.

These surveys have provided valuable information but have also indicated and emphasized the need for a thorough investigation of sawmill machinery and equipment with the object of increasing its efficiency.

With this in mind the Advisory Committee on Forestry has recommended to the Research Council of Ontario that support be given to a co-operative research program involving:

1. The establishment by the Dominion Forestry Branch of a research mill at the Forest Products Laboratory, Ottawa, in order to study in detail various factors affecting the efficiency of log utilization and sawmill operation. This mill would be established by the Federal Service and equipped to make fundamental studies which would be of interest to all lumber groups across Canada.

2. An investigation at the Department of Mechanical Engineering, University of Toronto, of fundamental mechanical engineering aspects of problems affecting sawmill machinery.

3. The establishment of a field mill that could be used either as a production mill or as a pilot mill to test on a practical scale the results obtained from the research mill.

Thus for Ontario we visualize a closely integrated program of research on this problem, involving co-operation between the Dominion Forestry Branch, the Ontario Department of Lands and Forests, certain departments of the University of Toronto and the Research Council of Ontario. It is hoped that as a result of this program significant advances will be made in many problems affecting the lumber industry.

**Integrated Utilization.**—Another approach to the problem of curtailment of waste might be through the development of a closer integration and correlation of the kinds and sizes of material available and the existing markets and also through the development of new markets or the re-allocation of old markets for material that otherwise would be wasted. What is known generally as "integrated utilization" simply means the harvesting of all the timber which should be cut from a forest (silviculturally) and its subsequent assignment to those uses to which it can be put to best advantage. Integration should also have regard to future crops of timber in any area logged and as far as is economically feasible, the avoidance of waste of raw material in all the various stages of manufacture.

Considerable progress along these lines has been made in the Scandinavian countries, and there are one or two outstanding examples in this country. For example, the International Paper Company in Quebec have a series of manufacturing plants involving the production of pulp and paper, ten-test, masonite, plywood and alcohol, each of which makes use of a different size or quality of raw material or of what would otherwise be the waste products of another conversion process. In general, however, our operations have as their objective a single product, e.g. pulp or lumber, and there has been little sympathy for developments toward a broader basis for management.

Furthermore the greatest weakness in the development and management of our farm woodlots in Southern Ontario has been the lack of a properly organized marketing system by which the material from a woodlot could be allocated to its most profitable use according to species and size. In this connection reference may be made to an actual case where 67 acres of nearly mature hardwood was sold for \$450. The stumpage alone on this woodlot if properly evaluated must have been worth \$6,000, and if the trees had been logged, carefully milled and sold according to their best use, it should have been well over \$20,000.



Integrated utilization was the principal topic of discussion at the last meeting of the Advisory Committee. As a result of recommendations made at that time, work is at present under way on summarizing the main problems involved in the better integration of wood utilization in this Province with reference both to industrial limits and private woodlots. From this work a recommendation may well come from our April meeting for the establishment possibly in co-operation with the Department of Lands and Forests of a central marketing organization in a suitable section of southern Ontario. This would be in the form of a pilot operation, one purpose of which would be to develop a pattern for use as a guide to developments elsewhere in this part of the Province.

### Forest Production

As pointed out above, the main problem affecting forest production with which the Advisory Committee has been concerned has been the regeneration of our most important tree species. Consideration has also been given to various aspects of forest protection.

**Regeneration.**—If our main objective in forestry is to ensure continuous yield from successive crops of trees, it is important to know whether or not our most desirable species are reproducing under present operating conditions. Over the past 30 years a number of surveys have been carried out by various agencies for this purpose. In most cases these surveys have been made independently of one another and often based on different standards of measurement and interpretation.

In 1947 the Advisory Committee on Forestry recommended that some one be appointed to bring together the ascertained facts of past regeneration surveys made in Ontario and to assess and appraise them with a view to making recommendations for further research. Professor R. C. Hosie of the Faculty of Forestry, University of Toronto, was asked to undertake this work.

So far this investigation shows that in the thirty odd regeneration surveys made in Ontario up to the present time there has been considerable variation in the method of survey used and in the analysis of results, so that in many cases the figures obtained from different surveys are not comparable.

Furthermore from an analysis of the results of these surveys it is apparent that on many areas regeneration has not been satisfactory following present methods of logging and that it will be necessary to determine through research the factors responsible for this lack of success. This phase of the problem will be considered by the Advisory Committee as soon as Professor Hosie's final report is available.

In the meantime with the failure of natural regeneration on many cut-over areas and in view of the desirability of establishing forests on extensive areas of abandoned farm land in southern Ontario that at present bear no



tree growth what ever, more and more use will have to be made of planting as a means of forest establishment. An important problem in this connection is to ensure that we use seed from the best existing stocks (genotypes) of the species in general use, develop improved types for certain species, and that as these types become recognized we have control over the source of seed to be used. In this connection a fundamental investigation into the factors affecting seed production in one species — red pine — is at present being made by Dr. Duff of the Department of Botany for the Department of Lands and Forests and with the support of the Research Council of Ontario.

**Forest Protection.**—This includes protection against insects and disease as well as fire.

(a) Forest Entomology and Pathology:

Losses due to insects and diseases represent 15% of the annual drain on the forests at the present time.

One of the most serious epidemics in recent years has been the so-called die-back of birch, which has killed most of the white and yellow birch in the Maritime Provinces and Maine — species that have been of vital importance to certain industries in that region. The primary causal agency of this condition has not yet been determined. As there were indications that this infestation was moving into Quebec and westward, it became a matter of concern to the Advisory Committee, which in 1948 set up a sub-committee to make recommendations for action if necessary. In the meantime, however, a co-operative program of research on this problem has been developed by the Ontario Department of Lands and Forests and the Dominion Divisions of Forest Entomology and Forest Pathology.

While the Advisory Committee has not made any recommendations for the initiation of specific projects either in Entomology or Pathology, it has kept in close touch with activities in both these fields, and at least once a year reports have been presented by representatives on the progress being made on the various problems under investigation. Thus at the Port Arthur meeting last May, Dr. Prebble and members of his staff from the Sault Ste. Marie Forest Entomological Laboratory reported to our committee on the situation with respect to the spruce budworm infestation in western Ontario, and at the Arnprior meeting in October representatives from both divisions reported on the position with regard to the birch die-back, and the pathologists gave an account of investigations being made into white pine decay in Ontario.

(b) Fire Protection:

Losses from fire represent nearly 8% of the annual depletion of our forests at the present time.

Problems concerned with forest fire prevention and suppression have mainly to do with (a) meteorological and fuel conditions affecting the fire hazard, (b) methods of locating forest fires as soon as possible after they start, and (c) methods and equipment for the most effective control of forest fires when once they are under way. During the past year the Research Council has been associated with the Research Division of the Department of Lands and Forests on investigations of micro-wave equipment for fire detection, fire weather forecasting and the testing of stellite-edged hand tools and mobile power units.

In addition, the Advisory Committee has been in close touch with work being done by the Forest Protection Division of the Dominion Forest Service and also has been associated to some extent with the Forest Protection Sub-Committee of the Associate Committee or Forestry of the National Research Council.

In view of the fact that the Provincial Government is responsible to a large extent for fire protection and that many of the problems will be determined to some extent at least by local conditions, it has been recommended by the Advisory Committee that a Fire Protection Sub-Committee be formed to have this important field under review and maintain close liaison with the Department of Lands and Forest and the Dominion Government groups that are concerned. This Sub-Committee has now been formed and will hold its first meeting in the near future.

## Organization of Research

**Group Research.**—The opportunities for small industries to co-operate in the study of problems of common interest under the group research plan have been brought to the attention of the Advisory Committee on Forestry and at the meeting of the Committee held at Port Arthur last May, Colonel D. F. McRae presented a paper on the information and research services available to industry.

**Co-ordinated Research on a Regional Basis.**—Owing very largely to the small number of men engaged in forestry research and the widespread demand for their services, there has been little opportunity to develop a co-ordinated research program in the Province. The tendency has been to attempt the solution usually by empirical means of individual problems or at a time by one or other of the agencies engaged in this field.

There are a large number of technical and economic problems that need attention before we can fully implement the policy of sustained yield management in our forests. While these problems may involve various branches of forestry, they are usually interrelated in their overall effect on forest management.

In view of the fact that the Province of Ontario may be divided into a number of regions, within each of which the natural and operating conditions have a general similarity, it is suggested that a more efficient approach would be through the establishment of a co-ordinated research program to embrace all common problems affecting sustained yield management within such a region. This would involve:

(a) The setting down of all known problems in order of their priority, indicating whether they are short-term or long-term and whether of an applied or fundamental nature.

(b) The development of a research program for the region, co-ordinating and integrating the work on the various problems as far as possible, having in mind the facilities and nucleus staff suggested below and possible assistance from agencies that specialize in certain aspects of forestry research.

(c) The appointment of a permanent research team of three or more specialists as a nucleus to organize and develop the program and ensure co-ordination and continuity of effort.

(d) The establishment of a research headquarters at some centre within the region from which field parties would be sent out and in which the compilation of data, writing of reports, consultations, etc., could be carried on.

(e) Close liaison with various forestry research agencies in the country with the object of having their representatives investigate certain problems for which they were best suited.

(f) The appointment of a capable administrator and research officer to be in charge of the whole research program for a region.

(g) The setting up of a small advisory committee, representing the main forestry interests in the region and the agencies chiefly concerned with the research program to assist the permanent research staff in the most efficient development of the program.

**Personnel Requirements for Research.**—If such a program of co-ordinated research is to be put into effect, many more suitably trained men will be required. In the past most of those taking post-graduate work in biological forestry have done so at one or other of the forest schools in the United States. It now becomes the responsibility of the Canadian Forestry Schools to provide the accommodation and facilities for such training. In view of this, the Advisory Committee on Forestry at its May, 1949, meeting supported the following resolution:

"The Forestry Committee in its discussions has found many problems for which foresters with a more advanced training are required.

"These problems arise not only in the course of the regular work done by foresters, but include problems of research.

"There is a keen demand for students with advanced training both from industry and the Government services. More students are becoming interested in this field and are available for further research training.

"The Committee recommends support from the Government for the provision of graduate facilities in Forestry. It further recommends that industry be asked to co-operate by providing field projects to give students an opportunity to do field research during the graduate course."

## Reports

"The Isolation and Fractionation of White Birch Holo-Cellulose," D. A. Sitch. Paper presented at the Annual Meeting of the Technical Section of the Canadian Pulp & Paper Association, Montreal, January 26-28, 1949.

"General Review of the Industrial Utilization of Waste Sulphite Liquor," H. Borden Marshall. Summary of an address presented to the Advisory Committee on Forestry, Research Council of Ontario, at Port Arthur on May 2, 1949.

"Detection of Fires by Radar," R. N. Johnston, H. R. Smyth, J. O. Wilhelm. R.C.O. Report No. 4-3-50, April, 1950.

"Fire Fighting Manual," prepared by Q. F. Hess with criticism by H. W. Green and W. Kitt. R.C.O. Report No. 4-2-50, April, 1950.

## ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: Mr. C. A. Pollock

Business succeeds in proportion to the "know-how" which it has available among its personnel. Therefore, if Ontario business is to develop by its own efforts and ingenuity, it needs research, and the utilization of the knowledge research can bring. When research plays a part in the thinking and activities of any business, there is a situation of continually improving knowledge, and progress becomes almost automatic. In the past, Canadian business has been too dependent upon U.K. and U.S. research developments and now is the time when realization of the vital place of research, in the progress of all industry becomes the "spring-board" from which industry in Canada and Ontario can advance by its own efforts.

Therefore, the activities of the Advisory Committee on Industrial Research become reasonably specific. The main purpose has been to help the Industrial Research Services Department of the Ontario Research Foundation serve the needs of industrial Ontario. The Committee actually becomes a public Relations Department of the Research Services Department, operating somewhat as follows:

- (a) Selling the idea and spreading the knowledge of research, one of the most important phases of its activities, to Ontario business.
- (b) Spreading knowledge of Ontario Research Foundation services and facilities.



(c) Aid Industrial Research Services Department in establishing policies concerning relations with smaller manufacturers.

(d) The members can aid Industrial Research Services Department personnel in their contacts. This applies to Field Service men, and their relationships with managers of business organizations, and with other personnel, in speaking engagements at Service Clubs, Chambers of Commerce, etc. The Committee members should keep the Research Foundation's activities in mind, in all their personal business contacts.

The activities of the Industrial Research Services Department have grown rapidly, and from a business man's point of view, it would be interesting to understand the relationship which presently exists between the potential volume of research activities, which could come from the 15,000 companies in the Province of Ontario, and the capacity for research work at the Foundation. During the year some 2,316 separate companies have made use of the facilities of the Department on 3,250 occasions and in about 28% of the cases laboratory work was required for which the company paid the cost.

From the above can be gleaned a pattern of activities which are carried on by the Advisory Committee on Industrial Research. As the Committee progresses, its activities will become more and more specific, and, as a result, the Committee will be able to render a better service.

During the year the scope of the Committee was broadened by the addition to membership of Mr. T. W. Brackinreid, Phillips Electrical Works, Brockville; Mr. W. J. W. Reid, President, Otis Elevator Company Limited, Hamilton; Mr. Lorne C. Anderson, Ontario Paper Co. Limited, Thorold; Mr. R. W. Keeley, President and General Manager, Bendix-Eclipse of Canada Limited, Windsor; Mr. D. W. Stewart, Jr., Renfrew; and Mr. J. N. Swinden, Great Lakes Lumber and Shipping, Ltd., Fort William. The business judgment and breadth of contact that these men bring to the Committee makes a valuable contribution.

To enlarge the contact with the thousands of small businesses throughout Ontario, an active Publicity Committee, under the Chairmanship of Mr. Lorne S. Campbell, has been working during the year and a program has been designed to use the best of the modern advertising techniques to bring the research in the Province to the attention of the industries that might best benefit from them.

The Industrial Research Services Division of the Foundation has been steadily enlarging its work. The organization has proved itself to be sound and, though the staff is working under some pressure, the service has been prompt and completely satisfactory. Discussions during the year have indicated the need of a Vitamin Assay Laboratory and an Applied Physics

Laboratory. During the year additional facilities in the field of Statistical Quality Control has been added to the services offered by this Division of the Foundation.

A group research in the canning field has been in progress this year. This largely developed through the personal activity of one of the Committee members, Mr. H. L. Bemis. The project in itself is complete, but the work has indicated a much wider field of endeavour.

Close co-operation has been maintained with the Canadian Manufacturers' Association, particularly the Ontario Division. The Committee have been invited to take an active part in the C.M.A. Annual Conference in May, 1950, when it is hoped a complete report of the activity of the Committee will be presented to the Industrial Research panel.

## ADVISORY COMMITTEE ON MINES, MINERALS AND METALLURGY

Chairman: Mr. N. F. Parkinson

The work of the Committee throughout the year has been conducted along lines designed to encourage research work having immediate prospect of practical application in the development of the Province's natural resources rather than to promote in the first instance fundamental research.

The chief activities carried on under this general policy were as follows:

### Wire Rope Testing Machine

This work supported by Council funds and carried out under the direction of Dr. Ellis in the Research Foundation, has been proceeding throughout the year. While there is much work yet to be done during the year, the data obtained to date have indicated that valuable information may eventuate with continuance of research. Generally speaking this year's work has been carried through with a view to establishing standards or curves to be used as comparisons as against the performance of ropes where other factors than loading and work imposed on the rope passing over the sheave or idling pulley, lead to their ultimate failure.

Considerable information has been gathered from this work which will appear in the more detailed report being prepared by Dr. Ellis and his associates and it is planned during the next and succeeding years of this work to introduce other factors, such as corrosive elements, from which comparative information with the basic data already collected, will be possible.

It is interesting to note in this connection that an Empire Symposium of papers on Hoisting Rope Practice, is being held in London, Eng., towards the end of 1950 at which papers from England, Africa and Canada will

presented dealing with practices and experience in those countries and performance of wire ropes used for mine hoisting purposes.

The Ontario Mining Association is presenting a paper on "Hoisting Rope Practice in Ontario Mines" and with that paper is going forward a short article describing the test apparatus provided by the Research Council of Ontario and now operating in the Ontario Research Foundation laboratories.

The Committee is happy to report further that after consultation with Dr. Speakman and Dr. Ellis, it seems assured that a member of Dr. Ellis's staff will attend the conference and will take with him later and more comprehensive description of the work being done on the rope testing machine with results as available up to perhaps the end of June. It would seem highly important that the Research Foundation investigators engaged in this work should keep abreast of similar work being carried on in other mining areas and a symposium arranged under the auspices of the Joint Committee of the British Iron and Steel Research Association, The Institution of Mechanical Engineers, The Institution of Mining Engineers and The Institution of Mining and Metallurgy, will offer an excellent opportunity for contacts of this nature.

An exact duplicate of the machine built under the auspices of the Research Council has been constructed by one of the larger oil companies here and is similarly operating in the accommodation of the Research Foundation, with a view to examining the effectiveness of different types of lubricants used for hoisting ropes. The parallel results to be obtained from this operation along with the results from the direct Council authorized research, will be very valuable.

### **Ferrous Metallurgy**

The general program of work in the field of ferrous metallurgy has been continued at the Ontario Research Foundation. Possible methods for reducing coke consumption in Canadian blast furnaces by the use of electric smelting equipment have been investigated. Work has been started in connection with processes for converting blast furnace dust and finely divided iron ores into lump form in order that these materials may be charged into a blast furnace and treated effectively.

Various methods of producing sponge iron as a substitute for scrap iron have been looked into. The Wiberg-Soderfors process investigated in Sweden on Canadian ores. The group research has continued on the tunnel kiln project for producing sponge iron.

The work contemplated on the commercial production of sponge iron as referred to in "Iron Age" of February, 1949, and financed originally by the steel industry and by funds recommended by the Research Council, has

been unfortunately delayed in starting due to a fire that destroyed the brick kiln where the reduction work was planned to take place. Delivery of the necessary equipment for the rebuilt brick kilns was held up and, as a result, this work will not now begin until April or May of this year.

### **Spectrographic Studies**

Dr. Hawley, who is in charge of this work which has been supported by the Research Council, has already made certain interim reports. Basic feature of the work is determination qualitatively and quantitatively of the presence of minor quantities of rare metals in ores by use of the spectrograph. If a practical method of utilizing the spectrograph can be worked out for this purpose it may have fairly wide application and be of economic importance since many ores contain small quantities of other metals difficult to isolate and difficult to determine as to quantity, in ordinary ways. For example, the Sudbury ores containing largely nickel and copper, contain also some eight or nine other metals in such minute quantities that they are incapable of assay ahead of time and yet their recovery has economic significance. Such metals include the platinum group metals, gold, silver, etc., and the value of all of these may only amount to about one-quarter of a cent or less per pound of nickel produced. Nevertheless individually some of these metals as indicated have economic importance and their determination beforehand will aid greatly in the determination of the method of eventual separation to be adopted.

### **Temperature Gradients in Ontario and Quebec**

Here certain work was carried out under the auspices of Professor A. D. Misener and covered in an article published in the C.I.M.M. Bulletin during the year. The imminence of deep mining in Ontario makes it important that conditions to be met with as to temperature at the lower levels may be determined with some degree of accuracy.

### **Radioactivity of Rocks and Structures**

Professor Wilson of the University of Toronto, has done a great deal of work with a view to tying in the relationship of radioactivity of our rock structure and rock temperature and ore deposition. The Research Council of Ontario has assisted to some extent the carrying on of this work which has been reported in a number of articles already published by Professor Wilson and others working with him.

### **Polarographic Analysis of Alloys**

Some assistance was provided to Professor Graham of McMaster University, for the conduct of some work in this field. Some progress has been made in the determination of aluminum in the important die-casting alloys and towards the development of a method for the determination of titanium in steels.



Two new lines of activity are under consideration — the first is a joint project with industry and looking to the use of the supersonic or mechanical wave in the non-destructive testing of wire rope. Both the committees appointed by the Government of Ontario following a serious hoisting accident that occurred some years ago, at one of the Ontario mines, recommended strongly that efforts be made to determine if possible changes taking place in the rope during service and with a view to anticipating failures. Certain work is already under way on this type of testing sponsored and being paid for by the Ontario Mining Association who have now invited the Research Council of Ontario to join with them under that section of the Act which permits joint financing of research projects with industry.

The second has to do with determination of the temperature of deposition of minerals in ores, with a view to facilitating the search for orebodies underground. It may be that some assistance will be recommended for that work during this year.

## Reports

- "Summary Report on Spectrographic Research," J. E. Hawley. R.C.O. Report No. 8-3-49.
- "Absorption of Alpha Rays in Thick Sources," J. Beharrell. Transactions American Geophysical Union, vol. 30, pp. 333-336, 1949.
- "Temperature Gradients in the Canadian Shield," A. D. Misener. Canadian Institute of Mining and Metallurgy Bulletin, vol. 42, pp. 280-287, 1949.
- "Temperature Gradients in Ontario and Quebec," A. D. Misener, L. D. G. Thompson. Canadian Institute of Mining and Metallurgy, Transactions, vol. 53, 1950. (Preprinted for Annual General Meeting, April, 1950.)
- "Radioactivity Measurements in the Kirkland Lake Area, Ontario," H. A. Slack. American Geophysical Union, Transactions, vol. 30, pp. 867-874, 1949.
- "An Extension of Lake's Hypothesis Concerning Mountain and Island Arcs," J. T. Wilson. Nature, vol. 164, pp. 147-148, 1949.
- "Some Major Structures of the Canadian Shield," J. T. Wilson. Canadian Institute of Mining and Metallurgy, Transactions, vol. 52, pp. 231-242, 1949.
- "The Origin of Continents and Precambrian History," J. T. Wilson. Royal Society of Canada, Transactions, vol. 43, pp. 157-184, 1949.

## ADVISORY COMMITTEE ON INDUSTRIAL WASTE

Chairman: Prof. A. C. Plewes

This group has continued its activity for the session 1949-50 in an advisory capacity, and has sought for the solution of the problem involving the disposal of milk wastes from plants located in the Province of Ontario. During the year several industrialists have been contacted and it is expected

that five new members will soon be added to the committee. In the meantime, A. C. Plewes has been appointed acting head of the committee until a permanent chairman can be chosen to replace the late E. T. Sterne.

It has become apparent during the last year that the solution of the problem will be difficult because of the size of the various plants associated with the milk industry. Preliminary studies of the problem were carried out in the summer of 1948 and were continued in 1949 by N. D. Woollings. It was obvious that the ultimate solution of the problem would involve some chemical or biochemical method of attack, and various tests were carried out in the Department of Health Laboratory on Richmond Street.

The study of the milk waste problem indicated two methods of attack (a) aerobic; (b) anaerobic.

Small scale laboratory and pilot-plant experiments were performed to check the merits of each method. It was found that the treatment of waste milk with trickling filters in the presence of air and aerobic bacteria gave effluent liquors that could be safely discharged to a stream or body of water. This type of unit, however, is most suitable for **large volumes of waste** products and requires **frequent cleaning and considerable supervision**. In contrast, method (b), the digestion of waste in absence of air and in the presence of anaerobic bacteria was an alternative choice. In general, it was found that the capital cost of this unit was greater per gallon of waste liquor treated. The effluent liquor, in addition, was less desirable than its aerobic counterpart and required final processing in a tile drainage bed before absorption in earth. However, this reaction might be carried out successfully in much **smaller installations**, and **much less supervision** would be required for its operation. It was thought desirable, however, to complete the studies quantitatively so that accurate cost data could be made available for various sized plants.

It was believed wise, therefore, to design larger units and find location for operation where the waste from a plant might be treated. It was then suggested, by this committee to the Research Council, that (\$20,000 be appropriated for Berry and his associates for one year's operating expense. During the coming year this group plans to instal and operate a 2,000 gallon-per-day anaerobic digester at Rutherford's Dairy near Toronto, and an aerobic unit of the same capacity at one of the plants near Caledonia, Western Ontario. The results from the operations of these two pilot plants would give valuable operating data as well as checking the research results on an operational scale.

The Committee are studying the wider problems of disposal of industrial waste in the Province. In co-operation with the other advisory research committees of the Council and industry, the Committee hopes to investigate other problems in the same way in which the milk waste problem has been studied.

The Committee has worked closely with the Sanitary Engineering Division of the Provincial Department of Health. They are of the opinion that the research and development facilities of the present laboratories should be more adequately housed and be expanded to provide for the work which will be required to develop adequate waste treatment methods and bring these into use in the Province.

## Reports

"Progress Report, Milk Waste Research," September 1, 1948 to November 15, 1949. N. D. Woollings.

## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Mr. W. S. McKay

Secretary: Mr. H. N. Lamont

In 1948 the Advisory Committee on Highways Research made two recommendations: (a) that a Highways Research Library be established; (b) that a highways research program be undertaken.

## Research Program

Implementation of the second recommendation has been carried out principally through the Department of Highways staff and laboratories. Research work has been undertaken on seven projects, namely:

Supporting value of subgrade soils and base courses

Soil classification

Granular inventory

Durability of aggregate

Design of bituminous mix

Traffic paint

Frost action

**Supporting Value of Subgrade Soils and Base Courses.** — During recent years highway and airport engineers have become increasingly aware of the need for scientifically determining the thickness of pavement and base course for any given wheel load. Most engineers agree that the greatest factor affecting this design is the supporting value of subgrade soils. A study of all laboratory and field testing methods led to the conclusion that the best method of approach was to perform plate bearing tests on various types of pavement base course and subgrade under actual field conditions. All laboratory testing of samples has been completed. Statistical analysis of all test data is proceeding satisfactorily. When this data is complete it is expected that preliminary design recommendations can be made.

**Soil Classification.**—There are an unusually large number of complex and varied soil types in the Province. In order to assemble and use the soil data to best advantage it becomes necessary to identify and name the various

soil types and to observe the road performance of each soil type. This procedure will permit an orderly cataloguing of soil data, the transfer of soil information from one locality to another, materially reduce future field and laboratory testing and permit non-technical personnel to use soil data much more readily. Although this work is a relatively slow process, satisfactory progress has been made during the last two years. It will be possible to apply the results of this research in the near future.

**Granular Inventory.**—In some areas of the Province the sources of granular material have become practically exhausted. In others the quality of aggregates has resulted in poor pavement performance. Before further construction is undertaken in these areas, a detailed granular inventory would be an invaluable asset. Fairly extensive field and laboratory investigations have been conducted, but during the past year this work has been curtailed due to lack of personnel. However, activities in this project will be materially increased in the near future.

**Durability of Aggregate.**—In several sections throughout the Province, the use of certain aggregates has resulted in poor pavement performance. The problem is to detect the deleterious aggregate, then to set specification limits for suitable materials and finally to discover possible treatments which will permit the use of inferior materials. During 1948 a considerable amount of work was done on this project but no definite conclusions were reached. During the past year work has been temporarily discontinued due to lack of personnel.

**Design of Bituminous Mix.**—During recent years traffic volume and wheel loadings have increased greatly. Pavements on some densely travelled highways and airports have shown signs of distress due to lack of stability. In some areas of the Province the use of previously considered inferior materials would be desirable for economical reasons. Hence it does appear necessary to obtain a method of determining the stability of bituminous mixes. A thorough study of bituminous pavements of various ages has been started to obtain fundamental information as to the physical properties and the effect of climatic conditions upon these pavements. Extensive laboratory testing of pavement samples is proceeding at Queen's University and at the Highways Laboratory in Toronto. The second phase of this project consists of the design of bituminous mixes. Based upon a study of newly constructed pavements, a procedure for preparing laboratory samples was established. These samples are tested for stability by means of the Trixie shear equipment. Work performed to date has been confined to conducting tests with various types of equipment and determining the proper testing procedure.

**Traffic Paint.**—The use of traffic paint for dividing highways into lanes has greatly increased, particularly since the war. The following problems relating to traffic paints have been apparent to the highway engineers for some time: (a) paints as delivered have had a wide range of consistency



(b) settlement of paint in storage has caused mixing and loading problems; (c) some application problems have been introduced by the use of glass beads of either the overlay or pre-mix type; (d) field performance such as discoloration, bleeding on bituminous pavements and traffic abrasion has varied considerably with different paints. After a thorough study of various paint testing methods and specifications it was decided to perform field service tests and to conduct physical laboratory tests. These tests are under way and certain tentative observations have been made. With the information obtained from this work and from further work which is planned, it is anticipated that a satisfactory traffic paint application will be prepared in the near future.

**Frost Action.**—The seriousness of frost action may be observed every spring in a large percentage of roads throughout the Province. Not only are the maintenance costs excessive but motorists suffer considerable inconvenience due to the unfavourable road conditions. It is generally agreed that for design purposes the following data should be obtained: (a) temperatures and moisture contents of subgrade soils during freezing weather; (b) the degree to which various soils are susceptible to frost action under normal design conditions; (c) various methods of treating soils by frost action. Detailed studies at locations where frost heaving has been recorded have been carried out. By correlation of water table functions, soil temperatures and moistures, soil types, and the extent of frost heaving, fundamental data will be obtained that will aid considerably in future design problems.

### Highways Research Library

As yet, the Committee's first recommendation that a complete Highways Research Library with a full-time librarian should be established and through this library a research extension or information service be set up, has not been realized. The Committee feels that this is a basic necessity in connection with any self-respecting research program. The recorded results of the research of others must be readily available for research workers.

### Indifference to the Importance of Research

The Highways Committee is concerned at the general indifference to the importance of research. No mention of an allocation for research has been made in the comprehensive five-year program of highways construction and maintenance that has been announced by the Government. In the United States, 2% of the Federal grant for highways is ear-marked for research. In Ontario, present highways research expenditure is about 1/20 of 1% of the amount spent. Lack of trained personnel and financial support for the training of personnel also hampers the conduct of a really comprehensive research program.

### Reports

"An Attempt to Control Snow Drifting by the Use of Elevated Inclined Snow Fence," C. Fraser, R.C.O. Report No. 5-2-49.

## ADVISORY COMMITTEE ON SOILS RESEARCH

Chairman: Dr. H. B. Speakman

Secretary: Mr. L. J. Chapman

The Soils Committee during the year has not been particularly active. The programs going forward at the Ontario Agricultural College, and at Vineland, as well as by the Department of Lands and Forests and the Ontario Research Foundation have all been progressing in a satisfactory manner. The monograph on a physiographic survey of Southern Ontario being prepared by Mr. Chapman is in the hands of the printer, and should be available for distribution toward the end of 1950. Plans are under discussion and will be presented to the Committee at an early date for the extension of this physiographic survey to Northern Ontario and for its further development in Southern Ontario.

The work on climatology has continued. Through co-operation with the Meteorological Services of the Department of Transport and the Arctic Institute, it was possible to extend some of the work outside of the Province and as far north as the Arctic Circle.

Research in the field of microbiology particularly as related to Soils has been developing in the Province, especially in the Department of Bacteriology at the Ontario Agricultural College.

Plans are taking shape and will be presented to the Committee covering a more comprehensive plan for the classification of research data on Soils to make such material more readily usable.

The Soil Survey that is being conducted by the Department of Agriculture within the Province through the Soils Committee, at Guelph, is continuing its work and to date eleven counties have been completely covered with published maps and reports outlining the result of the survey, while for more than 30 counties the field data is complete and maps and reports are being prepared.

## ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

Chairman: Prof. K. B. Jackson

Photographic surveying has been practised in Canada for over 50 years and these methods developed by the late Dr. Deville as Survey General for mapping the mountainous areas in the West are still in use though somewhat modified by improvements in photographic material, cameras, plotting instruments and means of transport. Equipment at

techniques in photographic surveying on the ground have remained relatively simple due largely to the ease with which the location of the camera station and the orientation of the camera may be determined, and in part to the limited scope of this method of surveying. Since the camera took to the air the problems involved have multiplied with every new application and with every effort to increase accuracy and reduce costs.

The perfect map cannot be produced by matching vertical photographs in a mosaic, tracing the required detail and ornamenting the remainder with conventional signs. The problem of combing a series of perspectives obtained from unknown points in space with unknown orientations to produce a plan of an irregular terrain at a predetermined scale is complicated. One can only admire the optimism of those who tackle the problem, and the ingenuity of those who solve it even approximately.

Photogrammetry, as this problem is called, is a comparatively new science which has been greatly benefited by parallel developments in photography and optical instruments. It is a very fruitful field for research and development.

In the general field of aerial surveying much work must be done. With respect to Committee work completed to date and in progress, the following are the major problems in hand:

1. Mr. Rooney of Photographic Survey Corporation submitted a report on some comparative experiments in photo geology. This report was subsequently published in Photogrammetric Engineering.

2. The Ontario Department of Lands and Forests submitted the problem of devising an aid for land float planes on "glassy water."

Preliminary investigations on this problem were made in the optical, sonic and supersonic fields but without success. In April, 1949, experiments were commenced on the conversion of a wartime radio altimeter for this purpose. In September the prototype was tested and then permanently installed in one of the Provincial Air Service planes. Tests have been carried out as weather permitted at Sault Ste. Marie with generally satisfactory results. The pilots report that with the device they can land on a much smaller lake than they would attempt landing on without it. Tests on ice and snow have been similarly successful. At present a second plane is being equipped and a technical report on the conversion and calibration details has been completed.

3. Work on transparencies and stereoscopes is in progress.

A light table has been designed and constructed. It provides adequate and uniform flickerless illumination without any appreciable rise in temperature of the working surface.

Densitometric measurements are being made of a series of transparencies supplied by the Air Survey Division of the Department of Lands and

Forests, to determine the optimum density range for the best interpretation of detail.

The best form of the stereoscope for use with transparencies is under consideration.

## ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH

Chairman: Mr. C. F. Luckham

One meeting of the Agriculture Committee was held November 17th, 1949. Several problems are being surveyed that will be brought to the attention of the Committee later. Some of these problems have arisen in connection with the activities of other research advisory committees. Though the Committee has not pursued any special problems, close contact has been maintained with the research work that has been going on at the Ontario Agricultural College at Guelph. A number of the graduates of the Ontario Agricultural College have taken advantage of the scholarships of the Research Council.

Government sponsored and supported research and investigation in agriculture are being done at several centres in the Province. Under the Dominion Department of Agriculture, Experimental Farms Service, experimental stations are operated at Ottawa, Harrow, Delhi, Smithfield, and Kapuskasing. The Dominion Science Service has laboratories at Ottawa, Harrow, Chatham, the University of Western Ontario, St. Catharines, Vineland, and Belleville.

The agricultural research program of the Ontario Department of Agriculture is centred in four branches: (1) The Ontario Agricultural College; (2) The Ontario Veterinary College; (3) The Horticultural Experiment Station, and the Horticultural Products Laboratory, both at Vineland, and (4) The Farm Economics Branch, at Toronto. Some experimental work also is being done at the Western Ontario Experimental Farm, Ridgeway, and the Agricultural School at Kemptville.

The projects under study include problems ranging all the way from those of land use and soil conservation, through horticultural and field crop breeding, production, and improvement, insect pests and diseases control, weed eradication, livestock and poultry breeding, feeding and management, animal diseases, storage and processing of fruits and vegetables, to actual costs of production studies of both livestock and crops.

Some of these research problems are of a kind requiring continued study over a period of several years; some are of such a nature that the required answers may be found in a shorter time of one or two years, or even a few months of intensive field and/or laboratory study.

Most of these problems, however, are being investigated because they have been encountered in, or are related to, practical farm operations. They



are problems for which we do not have the answers, and for which the information is urgently needed.

Agricultural research has become increasingly complex and difficult with the aging of the industry, and its continual need for adjustment of practices to suit changing conditions. Few are the opportunities to-day, for one research worker by himself, to make a phenomenal discovery or achievement in agricultural research. (Most, if not all, of the easy problems have been solved.) The agricultural problems with which we are faced to-day are mostly of a kind requiring the combined and concentrated efforts of several research specialists, working together within a co-ordinated plan or program, for their satisfactory solution. Recognition of this important principle has led to the development of the "group research projects" which are organized and conducted under the direction of committees of specialists, representing the various interests and the scientific and technical departments involved in the study.

Examples of this trend toward the co-operative approach, are the Legume Research Committee, the Potato Scab Research Committee, and the Tree Fruits Pollination Committee. In each case, the committee personnel includes specialists from the Dominion Experimental Farms Service, the Dominion Science Service, and as well, specialists from the Provincial Experiment Stations, and from several departments of the Ontario Agricultural College. The Potato Scab Research Committee also includes in its personnel a member of the faculty of the University of Western Ontario, who has been working on the potato scab problem.

The most recent addition to the research facilities of the Ontario Department of Agriculture is the new, splendidly equipped Horticultural Products Laboratory at the Horticultural Experiment Station, Vineland, just completed during 1950. With a staff giving full time to research, fifteen projects are under way on storage and processing problems with fruits, fruit juices, and vegetables. This laboratory is situated ideally, being in the heart of the Niagara fruit district, where an abundance and variety of fruit and vegetable crops are available to provide material for year round investigation. Further, this laboratory, being on the grounds of the Experiment Station, with its other laboratories, and within 10 minutes drive to the Dominion Laboratory of Plant Pathology at St. Catharines, and with its work closely co-ordinated with that of the Horticultural Department of the Ontario Agricultural College, enjoys all the advantages of collaboration of groups of specialists in the horticultural and allied fields.

A preliminary listing of the agricultural research projects being done in the four branches of the Ontario Department of Agriculture has been completed, and is now in the course of a second revision.

The Ontario Research Foundation has begun research into the utilization of agricultural products. The opportunity for contact with the other active research divisions in the Foundation should provide a helpful stimulus.



# APPENDIX I

## STATEMENT OF EXPENDITURE For the Year Ended 31st March, 1950

### ADMINISTRATION:

Salaries .....	\$ 11,507.64	
Maintenance .....	4,115.72	
Travelling .....	4,364.61	
		\$ 19,987.97
SCHOLARSHIPS .....		48,995.00

### GRANTS AND PROJECTS:

#### Ontario Research Foundation

Wire Rope .....	\$13,628.62	
Ferrous Metallurgy .....	24,146.53	
Parasitology .....	30,278.53	
Physiography .....	16,179.11	
Wood Chemistry .....	23,034.10	
Utilization of Agricultural Products .....	3,951.23	
Industrial Research Services .....	51,187.11	
		162,405.23

#### University of Toronto

Fisheries and Wildlife .....	17,500.00	
Geophysics .....	8,000.00	
		25,500.00

#### Royal Ontario Museum of Zoology

Fisheries and Wildlife .....	10,500.00	
		10,500.00

#### McMaster University

Zoology .....	5,800.00	
Botany .....	2,000.00	
Organic Chemistry .....	650.00	
Alloy Analysis .....	550.00	
		9,000.00

#### Queen's University

Fisheries .....	4,850.00	
Spectrographic Studies .....	4,250.00	
Forest Regeneration .....	1,400.00	
Entomology .....	2,500.00	
		13,000.00

#### University of Western Ontario

Fisheries .....	7,500.00	
		7,500.00

#### Department of Health

Milk Waste .....	11,980.82	
		11,980.82
		239,886.05
GROUP RESEARCH .....		25,500.00

\$334,369.02

## APPENDIX II

### SCHOLARSHIP AWARDS — 1949-50

Name	Scholarship University	Award
Anderson, D. V.	University of Toronto	\$1,000.00
Batzold, J. S.	University of Western Ontario	750.00
Bennett, Miss W. C. G.	Queen's University	750.00
Bromley, D. A.	University of Rochester	1,000.00
Burns, C. A.	Queen's University	750.00
Carman, G. M.	Iowa State University	750.00
Chapman, J. H.	McGill University	750.00
Chung, J. H.	University of Toronto	900.00
Crosby, D. G., Jr.	Stanford University	750.00
Douglas, R. J.	Ontario Agricultural College	750.00
Duncan, J. W. L.	University of Toronto	750.00
Dunn, D. W.	Massachusetts Institute of Technology	900.00
Duret, M. F.	University of Toronto	900.00
Evans, Miss D. H.	Queen's University	750.00
Forsyth, F. R.	University of Toronto	750.00
George, J. D.	University of Toronto	750.00
Godfrey, H.	University of Toronto	900.00
Griffiths, H. D.	McGill University	750.00
Harrower, G. A.	McGill University	750.00
Harvey, J. D.	Ontario Agricultural College	900.00
Heimpel, A. M.	University of California	750.00
	Travel Grant	75.00
Hines, C. O.	University of Toronto	750.00
Howell, W. E.	University of Minnesota	750.00
James, D. H.	Queen's University	750.00
Lillie, A. B.	Rice Institute	900.00
McCombie, A. M.	University of Toronto	700.00
McDonald, C. C.	University of Western Ontario	750.00
McElcheran, D. E.	McMaster University	750.00
MacKenzie, I. K.	University of British Columbia	900.00
McKnight, T. S.	Queen's University	750.00
McLauchlan, T. A.	University of Toronto	700.00
McMullen, C. C.	McMaster University	750.00
Maxwell, J. A.	McMaster University	750.00
Miller, R. J.	McMaster University	700.00



Name	Scholarship University	Award
Milne, I. H.	University of Toronto .....	900.00
Nixon, W. C.	Cambridge University .....	900.00
	Travel Grant .....	125.00
Page, J. A.	McMaster University .....	750.00
Peirce, R. W.	McMaster University .....	750.00
Petch, H. E.	McMaster University .....	750.00
Slack, H. A.	University of Toronto .....	1,000.00
Smith, Miss F. I.	University of Toronto .....	750.00
Smith, F. D.	University of Rochester .....	750.00
Snyder, R. A.	University of Western Ontario .....	900.00
Steenberg, N. R.	Queen's University .....	750.00
Strickland, K. P.	University of Western Ontario .....	750.00
Szabo, A. J.	McMaster University .....	750.00
Teghtsoonian, E.	University of Toronto .....	750.00
Teichroew, D.	University of North Carolina .....	900.00
Vallentyne, J. R.	Yale University .....	750.00
Versteeg, J.	University of Western Ontario .....	750.00
Vittorio, P. V.	Queen's University .....	900.00
Warren, Miss A. A.	University of Toronto .....	900.00
Watson, H. A.	Massachusetts Institute of Technology	750.00
Wilson, D. G.	Queen's University .....	750.00
Whitaker, Miss J. F. M.	University of British Columbia .....	750.00
Wolfe, Raymond	University of Toronto .....	750.00
Wolfe, R. I.	University of Toronto .....	1,000.00
Worsley, Miss B. H.	Cambridge University .....	1,000.00

## APPENDIX III

### ADVISORY COMMITTEES

#### AERIAL SURVEY RESEARCH

##### Main Committee:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin.	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Mr. J. A. Brodie	Ontario Dept. of Lands and Forests
Mr. L. J. Chapman	Ontario Research Foundation
Dr. W. Clark	Eastman Kodak Company, Kodak Park Works
Dr. D. R. Derry	Ventures Limited
Mr. W. J. Fulton	Ontario Dept. of Highways
Dr. L. E. Howlett	Physics, National Research Council
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. W. J. Jackson	Williamson Co. of Canada, Ltd.
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Co. Ltd.
Mr. S. T. B. Losee	Abitibi Power and Paper Co. Ltd.
Prof. O. J. Marshall	Civil Engineering, University of Toronto
Prof. F. F. Morwick	Soils, Ontario Agricultural College
Prof. J. E. Reid	Electrical Engineering, University of Toronto
Mr. A. H. Richardson	Ontario Dept. of Planning and Development
Mr. J. R. G. Smyth	Ontario Dept. of Lands and Forests

Meetings: February 16th, 1950, Photographic Survey Co., Toronto

##### Executive:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Co. Ltd.
Mr. A. H. Richardson	Ontario Dept. of Planning and Development

Meetings: November 14th, 1949, 39 Queen's Park, Toronto.

##### Photography:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited

Mr. J. M. Bishop  
 Mr. R. N. Johnston  
 Mr. D. N. Kendall

Ontario Dept. of Lands and Forests  
 Ontario Dept. of Lands and Forests  
 Photographic Survey Co. Ltd.

### Photogrammetry:

Prof. K. B. Jackson  
 (Chairman)  
 Mr. K. H. Siddall  
 Mr. L. G. Timpson  
 Prof. W. M. Treadgold  
 Mr. J. G. Wilkinson

Applied Physics, University of Toronto  
 Ontario Dept. of Highways  
 Ontario Dept. of Land and Forests  
 Civil Engineering, University of Toronto  
 Photographic Survey Co. Ltd.

## AGRICULTURAL RESEARCH

### Main Committee:

Mr. C. F. Luckham  
 (Chairman)  
 Mr. Ken Betzner  
 Mr. J. Gordon Blair  
 Dr. H. D. Branion  
 Prof. C. G. E. Downing  
 Prof. E. H. Garrard  
 Dr. E. S. Hopkins  
 Prof. R. G. Knox  
 Mr. Lawrence Kerr  
 Dr. A. L. MacNabb  
 Mr. M. H. McCurdy  
 Dr. G. P. McRostie  
 Dr. K. W. Neatby  
 Dr. E. F. Palmer  
 Mr. A. Pitt  
 Mr. F. W. Presant  
 Prof. G. N. Ruhnke  
 Mr. G. A. Schell  
 Mr. J. C. Steckly  
 Mr. W. G. Toner  
 Mr. S. B. Trainer

Norfolk Specialty Farms  
 R.R. No. 2, Waterloo  
 Niagara Brand Spray Company Limited  
 Animal Nutrition, Ontario Agricultural College  
 Agricultural Engineering, Ontario Agricultural College  
 Bacteriology, Ontario Agricultural College  
 Central Experimental Farm, Dominion Dept. of Agriculture  
 Animal Husbandry, Ontario Agricultural College  
 Chatham  
 Ontario Veterinary College  
 Cockshutt Plow Company Limited  
 Field Husbandry, Ontario Agricultural College  
 Science Service, Dominion Dept. of Agriculture  
 Horticultural Experiment Station, Ontario Dept. of Agriculture  
 Massey-Harris Company Limited  
 Toronto Elevators Limited  
 Research, Ontario Agricultural College  
 Canada Packers Limited  
 Western Ontario Experimental Farm, Ontario Dept. of Agriculture  
 Charles Yeates & Co. Limited  
 Silverwood Dairies, Limited

Mr. George Wilson  
Mr. S. M. Young

Fruit Branch, Ontario Dept. of Agriculture  
International Harvester Company of Canada  
Limited

### Co-Ordinating Committee:

Dr. H. D. Branon  
(Chairman)

Animal Nutrition, Ontario Agricultural College

Prof. C. G. E. Downing

Agricultural Engineering, Ontario Agricultural College

Mr. C. F. Luckham

Norfolk Specialty Farms

Dr. E. F. Palmer

Horticultural Experiment Station, Ontario Dept. of Agriculture

Mr. George Wilson

Fruit Branch, Ontario Dept. of Agriculture

Dr. E. W. Hopkins  
(Advisory)

Central Experimental Farm, Dominion Dept. of Agriculture

Dr. K. W. Neatby  
(Advisory)

Science Service, Dominion Dept. of Agriculture

## FISHERIES AND WILDLIFE RESEARCH

### Main Committee:

Prof. J. R. Dymond  
(Chairman)

Zoology, University of Toronto

Dr. A. M. Fallis  
(Secretary)

Parasitology, Ontario Research Foundation

Dr. H. Battle

Zoology and Applied Biology, University of Western Ontario

Dr. A. O. Blackhurst

Ontario Federation of Commercial Fishermen

Dr. C. H. D. Clarke

Ontario Dept. of Lands and Forests

Prof. A. F. Coventry

Zoology, University of Toronto

Dr. H. W. Curran

Biology, Queen's University

Dr. C. D. Fowle

Ontario Dept. of Lands and Forests

Dr. F. E. J. Fry

Zoology, University of Toronto

Dr. W. J. K. Harkness

Ontario Dept. of Lands and Forests

Mr. L. Hughes

Northern Ontario Outfitters' Assn.

Prof. F. P. Ide

Zoology, University of Toronto

Dr. W. H. Johnson

Zoology and Applied Biology, University of Western Ontario

Mr. R. N. Johnston

Ontario Dept. of Lands and Forests

Dr. R. R. Langford

Zoology, University of Toronto

Mr. H. H. MacKay

Ontario Dept. of Lands and Forests

Mr. K. M. Mayall

Ontario Dept. of Planning and Development

Mr. W. Austin Peters

Ontario Federation of Anglers and Hunters



Dr. N. W. Radforth	Botany, McMaster University
Mr. Lester L. Snyder	Royal Ontario Museum of Zoology
Dr. W. M. Sprules	Zoology and Applied Biology, University of Western Ontario
Dr. F. A. Urquhart	Royal Ontario Museum of Zoology
Dr. A. Emerson Warren	Zoology, McMaster University

Meetings: October 1st, 1949, McMaster University, Hamilton.  
February 24th, 1950, Queen's University, Kingston.

#### **Executive:**

Prof. J. R. Dymond (Chairman)	Zoology, University of Toronto
Dr. A. M. Fallis (Secretary)	Parasitology, Ontario Research Foundation
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Dr. A. Emerson Warren	Zoology, McMaster University

Meetings: March 18th, 1950, 39 Queen's Park, Toronto.

#### **Technical Session, 1949/50**

Dr. H. W. Curran (Chairman)	Biology, Queen's University
Prof. R. O. Earl	Biology, Queen's University
Dr. C. D. Fowle	Ontario Dept. of Lands and Forests
Mr. W. Austin Peters	Ontario Federation of Anglers and Hunters

Meetings: February 24th and 25th, 1950, Queen's University,  
Kingston.

#### **Research on Parasites and Diseases in Relation to Fisheries and Wildlife**

Dr. A. M. Fallis (Chairman)	Parasitology, Ontario Research Foundation
Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests
Dr. C. D. Fowle	Ontario Dept. of Lands and Forests
Dr. A. A. Kingscote	Ontario Veterinary College
Dr. J. F. A. Sprent	Ontario Research Foundation
Dr. F. A. Urquhart	Royal Ontario Museum of Zoology

#### **Great Lakes Fisheries Research**

Mr. R. N. Johnston (Chairman)	Ontario Dept. of Lands and Forests
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen

Prof. J. R. Dymond	Zoology, University of Toronto
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests

## Wildlife

Dr. C. D. Fowle (Chairman)	Ontario Dept. of Lands and Forests
Dr. H. I. Battle	Zoology and Applied Biology, University of Western Ontario
Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. A. E. Warren	Zoology, McMastery University

Meetings: May 4th, 1949, 39 Queen's Park, Toronto.  
 July 30th, 1949, Queen's University Biological Station,  
 Chaffey's Locks.

## Research on Plants in Relation to Wildlife

Dr. C. D. Fowle (Chairman)	Ontario Dept. of Lands and Forests
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests
Mr. K. M. Mayall	Ontario Dept. of Planning and Development
Dr. N. W. Radforth	Botany, McMaster University
Dr. J. H. Soper	Zoology, University of Toronto

## Publicity

Mr. K. M. Mayall (Chairman)	Ontario Dept. of Planning and Development
Dr. N. W. Radforth	Botany, McMaster University
Dr. W. M. Sprules	Zoology and Applied Biology, University of Western Ontario

## FORESTRY RESEARCH

### Main Committee:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Dept. of Planning and Development
Mr. H. W. Beall	Dominion Dept. of Resources and Development
Dr. John E. Bier	Dominion Laboratory of Forest Pathology
Mr. G. G. Cosens	Kimberly-Clark Corporation Limited

Mr. W. A. Delahey	Consulting Forester
Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College
Prof. G. H. Duff	Botany, University of Toronto
Mr. T. L. Dunbar	Consultant, Forest Utilization
Prof. R. O. Earl	Biology, Queen's University
Mr. D. A. Gillies	Gillies Bros. and Co. Ltd.
Mr. J. H. Godden	Great Lakes Paper Company
Dr. O. Holden	Engineering, The Hydro-Electric Power Commission of Ontario
Prof. R. C. Hosie	Forestry, University of Toronto
Col. J. H. Jenkins	Dominion Dept. of Resources and Development
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Maj.-Gen. H. Kennedy	Consulting Engineer
Mr. A. Koroleff	Pulp and Paper Research Institute of Canada
Mr. W. J. LeClair	Canadian Lumbermen's Association
Mr. G. A. Ledingham (Associate member)	National Research Council Regional Laboratory, Saskatoon.
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests
Mr. D. A. Macdonald	Dominion Dept. of Resources and Development
Mr. J. B. Matthews	Abitibi Power and Paper Company Limited
Mr. T. A. McElhanney	Grimsby
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Mr. C. R. Mills	Ontario Forest Industries Association
Dr. M. L. Prebble	Forest Insect Laboratory
Mr. K. O. Roos	Booth Lumber Limited
Mr. S. J. Staniforth	Staniforth Lumber Co. Limited
Dr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited
Mr. G. Tunstell	Dominion Dept. of Resources and Development

Meetings: May 2nd-3rd, 1949, Prince Arthur Hotel, Port Arthur.  
October 5th-6th, 1949, "The Grove", Arnprior.

#### Executive:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Dept. of Planning and Development
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. J. B. Matthews	Abitibi Power and Paper Company Limited

Prof. R. R. McLaughlin      Chemical Engineering, University of Toronto

Meetings: September 29th, 1949, 39 Queen's Park, Toronto.

December 6th, 1949, 39 Queen's Park, Toronto.

March 31st, 1950, 39 Queen's Park, Toronto.

### Fire Control:

Mr. J. B. Matthews  
(Chairman)

Mr. M. H. Baker

Mr. A. S. L. Barnes

Mr. J. C. Dillon

Mr. Q. F. Hess

Mr. R. N. Johnston

Prof. A. S. Mitchell

Mr. James Ruxton

Dean J. W. B. Sisam

Abitibi Power and Paper Co. Limited

Ontario Dept. of Lands and Forests

Ont. Dept. of Planning and Development

Ontario Dept. of Lands and Forests

Ontario Dept. of Lands and Forests

Ontario Dept. of Lands and Forests

Forestry, University of Toronto

Ontario Dept. of Lands and Forests

Forestry, University of Toronto

Meetings: November 14th, 1949, (Preliminary), 39 Queen's Park  
Toronto.

### Wood Chemistry:

Dr. H. B. Marshall  
(Chairman)

Dr. G. A. Adams

Dr. F. Bender

Dr. G. A. Ledingham

Ontario Research Foundation

Applied Biology, National Research Council

Forest Products Laboratory of Canada

National Research Council Regional Laboratory  
Saskatoon.

Prof. R. R. McLaughlin

Dr. G. H. Tomlinson, II

Chemical Engineering, University of Toronto

Howard Smith Paper Mills Limited

### Forest Biology:

Mr. A. P. Leslie  
(Chairman)

Mr. A. B. Baird

Mr. G. G. Cosens

Mr. W. A. Delahey

Prof. G. H. Duff

Prof. R. O. Earl

Prof. R. C. Hosie

Mr. R. N. Johnston

Maj.-Gen. H. Kennedy

Mr. D. A. Macdonald

Ontario Dept. of Lands and Forests

Science Service, Dominion Dept. of Agriculture

Kimberly-Clark Corporation Limited

Consulting Forester

Botany, University of Toronto

Biology, Queen's University

Forestry, University of Toronto

Ontario Dept. of Lands and Forests

Consulting Engineer

Dominion Dept. of Resources and Development



Mr. C. R. Mills	Ontario Forest Industries Association
Mr. K. O. Roos	Booth Lumber Limited
Prof. J. W. B. Sisam	Forestry, University of Toronto
Mr. W. E. Willson	Abitibi Power and Paper Company Ltd.

Meetings: April 28th, 1949, 39 Queen's Park, Toronto.  
 July 25th, 1949, 39 Queen's Park, Toronto.  
 December 6th, 1949, 39 Queen's Park, Toronto  
 March 17th, 1950, 39 Queen's Park, Toronto.

### **Sawmilling Practice:**

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. W. J. LeClair	Canadian Lumbermen's Association
Mr. T. A. McElhanney	Grimsby
Mr. K. O. Roos	Booth Lumber Limited
Mr. J. F. Sharpe	Ontario Dept. of Lands and Forests
Mr. S. J. Staniforth	Staniforth Lumber Co. Limited
Mr. G. J. Thomson	Peter Thomson and Sons

Meetings: September 21st, 1949, 39 Queen's Park, Toronto.

### **Waste Slabwood Utilization:**

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Mr. W. J. LeClair	Canadian Lumbermen's Association
Dr. H. B. Marshall	Ontario Research Foundation
Mr. T. A. McElhanney	Grimsby
To be named	Forest Products Laboratory, Dominion Dept. of Resources and Development

## **HIGHWAYS RESEARCH**

### **Main Committee:**

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways
Mr. T. N. Carter	Carter Construction Co. Ltd.
Mr. L. J. Chapman	Physiography, Ontario Research Foundation
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways

Mr. W. B Hastings	Ontario Motor League
Mr. A. K. Hay	Federal District Commission
Prof. R. A. Low	Civil Engineering, Queen's University
Mr. J. A. P. Marshall	Chief Municipal Engineer
Dr. N. W. McLeod	Imperial Oil Limited
Mr. W. J. Moore	Ontario Municipal Board
Mr. C. A. Robbins	Ontario Dept. of Highways
Mr. D. O. Robinson	Canada Cement Co.
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. Walter	Ontario Dept. of Highways
Mr. R. B. Young	Ontario Hydro-Electric Power Commission
Mr. Richard Elliott (Ex-officio)	Ontario Good Roads Association
Mr. T. D. Miller (Ex-officio)	Miller Paving Co.

Meetings: July 8th, 1949, Board Room, Department of Highways,  
Toronto.

### Organization:

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways
Mr. A. K. Hay	Federal District Commission
Prof. R. A. Low	Civil Engineering, Queens University
Dr. N. W. McLeod	Imperial Oil Limited
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. Walter	Ontario Dept. of Highways

Meetings: June 10th, 1949, 39 Queen's Park, Toronto.  
July 7th, 1949, 39 Queen's Park, Toronto.  
November 25th, 1949, 39 Queen's Park, Toronto.  
January 27th, 1950, 39 Queen's Park, Toronto.

### Planning, Economics and Administration:

Prof. R. A. Low (Chairman)	Civil Engineering, Queen's University
Mr. A. E. K. Bunnell	Ontario Dept. of Planning and Development
Mr. W. A. Clarke	Ontario Dept. of Highways
Mr. G. R. Marston	County Engineer, Simcoe
Mr. W. J. Fulton	Ontario Dept. of Highways

Mr. J. M. MacInnes	Ontario Dept. of Highways
Mr. J. L. Zoller	Ontario Dept. of Highways

### Design:

Mr. D. J. Emrey (Chairman)	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways
Mr. R. M. Lee	County Engineer, Brantford
Dr. N. W. McLeod	Imperial Oil Limited
Mr. D. G. Ramsay	Ontario Dept. of Highways
Mr. D. O. Robinson	Canada Cement Co.
Mr. J. Walter	Ontario Dept. of Highways

### Soils and Foundations:

Mr. J. Walter (Chairman)	Ontario Dept. of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Prof. R. A. Low	Civil Engineering, Queen's University
Mr. A. D. McGinnis	McGinnis and O'Connor
Dr. N. W. McLeod	Imperial Oil Limited
Mr. D. G. Watt	Ontario Hydro-Electric Power Commission

Meetings: April 1st, 1949, 39 Queen's Park, Toronto.

### Materials and Construction:

Mr. T. F. Francis (Chairman)	Ontario Dept. of Highways
Mr. C. Fraser	Ontario Dept. of Highways
Mr. T. Johnston	Ontario Dept. of Highways
Mr. E. W. Jones	County Engineer, Barrie
Mr. T. R. Patterson	County Engineer, Goderich
Prof. W. L. Sagar	Civil Engineering, University of Toronto

Meetings: April 1st, 1949, 39 Queen's Park, Toronto.

## INDUSTRIAL RESEARCH

### Main Committee:

Mr. C. A. Pollock (Chairman)	Dominion Electrohome Industries, Limited
Mr. Lorne C. Anderson	Ontario Paper Co. Limited
Mr. H. L. Bemis	Campbell Soup Company Limited
Mr. G. C. Bernard	Canadian Manufacturers' Association Inc.
Mr. T. W. Brackinreid	Phillips Electrical Works

Mr. Lorne S. Campbell	Ontario Dept. of Planning and Development
Mr. Howard Chamberlain	Lowe Brothers Co. Ltd.
Mr. T. A. Faust	Yocum Faust, Limited
Mr. R. W. Keeley	Bendix-Eclipse of Canada Limited
Col. F. J. Lyle	Ontario Dept. of Planning and Development
Col. D. F. MacRae	Ontario Research Foundation
Mr. W. J. W. Reid	Otis Elevator Company Limited
Dr. H. B. Speakman	Ontario Research Foundation
Mr. D. W. Stewart, Jr.	Renfrew
Mr. D. B. Strudley	Imperial Rattan Co. Limited
Mr. J. N. Swinden	Great Lakes Lumber and Shipping, Ltd.
Mr. A. B. Ward	Ontario Research Foundation

Meetings: April 22nd, 1949, 39 Queen's Park, Toronto.  
 July 5th, 1949, 39 Queen's Park, Toronto.

September 19th, 1949, North Common Room, Hart House  
 Toronto.

December 1st, 1949, North Common Room, Hart House  
 Toronto.

January 25th, 1950, North Common Room, Hart House  
 Toronto.

#### Patents:

Col. D. F. MacRae	Ontario Research Foundation
Dr. H. B. Speakman	Ontario Research Foundation
Prof. J. O. Wilhelm	Research Council of Ontario

#### Publicity:

Mr. Lorne S. Campbell (Chairman)	Ontario Dept. of Planning and Development
Mr. H. L. Bemis	Campbell Soup Company Limited
Mr. G. C. Bernard	Canadian Manufacturers' Association Inc.
Mr. Howard Chamberlain	Lowe Brothers Co. Ltd.
Col. D. F. MacRae	Ontario Research Foundation

### INDUSTRIAL WASTE

#### Main Committee:

Prof. A. C. Plewes (Chairman)	Chemical Engineering, Queen's University
Dr. A. E. Berry	Ontario Dept. of Health
Mr. G. A. H. Burn	Ontario Dept. of Health



Mr. A. V. Delaporte	Ontario Dept. of Health Experimental Station
Mr. H. S. Matthews	Matthews-Wells Company Limited
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Mr. A. E. Proctor	Brantford Produce Co. Limited
Dr. H. B. Speakman	Ontario Research Foundation

Meetings: November 18th, 1949, 39 Queen's Park, Toronto.

December 16th, 1949, 39 Queen's Park, Toronto.

February 10th, 1950, Dept. of Health Experimental Laboratories, Toronto.

## MINES, MINERALS AND METALLURGY

### Main Committee:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Prof. H. S. Armstrong	Geology, McMaster University
Prof. O. A. Carson	Metallurgy, Queen's University
Dr. O. W. Ellis	Ontario Research Foundation
Dr. C. S. Evans	Union Gas Company of Canada, Limited
Dr. G. S. Farnham	The International Nickel Company of Canada Limited
Dr. D. L. H. Forbes	The Teck-Hughes Gold Mines, Limited
Mr. T. W. Hardy	Climax Molybdenum Company
Prof. J. E. Hawley	Mineralogy, Queen's University
Prof. L. M. Pidgeon	Metallurgical Engineering, University of Toronto
Prof. G. H. Reavely	Geology and Geography, University of Western Ontario
Mr. H. C. Rickaby	Ontario Dept. of Mines
Mr. R. H. Rimmer	Aluminium Laboratories Limited
Mr. W. Samuel	Steep Rock Iron Mines Limited
Mr. W. B. Timm	Ottawa
Dr. C. R. Whittemore	Deloro Smelting and Refining Co. Limited
Dr. G. E. Willey	Algoma Steel Corporation, Limited
Prof. C. G. Williams	Toronto
Prof. J. T. Wilson	Physics, University of Toronto
Mr. R. B. Young	Hydro-Electric Power Commission

### Executive:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Dr. O. W. Ellis	Ontario Research Foundation

Mr. H. C. Rickaby  
Prof. C. G. Williams  
Mr. R. B. Young

Ontario Dept. of Mines  
Toronto  
Hydro-Electric Power Commission

Meetings: April 14th, 1949, 39 Queen's Park, Toronto.  
October 26th, 1949, 39 Queen's Park, Toronto.  
February 3rd, 1950, 39 Queen's Park, Toronto.

### Wire Rope:

Dr. O. W. Ellis  
(Chairman)

Ontario Research Foundation

Mr. I. A. Usher  
(Secretary)

Ontario Research Foundation

Mr. N. B. Brown

Bureau of Mines

Mr. R. E. Dye

Dome Mines Limited

Mr. R. L. Healy

Wright-Hargreaves Mines Limited

Mr. A. C. Halferdahl

National Research Council

Mr. W. E. Brown

B. Greening Wire Co. Limited

Mr. J. G. Morrow

Steel Company of Canada Limited

Mr. R. D. Parker

International Nickel Co. of Canada, Limited

Mr. N. F. Parkinson

Ontario Mining Association

Mr. R. S. Segsworth

General Engineering Co. (Canada) Limited

Mr. D. G. Sinclair

Ontario Dept. of Mines

Mr. L. W. Sproule

Imperial Oil Limited

Mr. R. B. Young

Hydro-Electric Power Commission

Meetings: June 29th, 1949, 43 Queen's Park Toronto.

### Ferrous Metallurgy:

Dr. O. W. Ellis  
(Chairman)

Ontario Research Foundation

Mr. P. E. Cavanagh  
(Secretary)

Ontario Research Foundation

Mr. T. W. Hardy

Climax Molybdenum Company

Mr. F. A. Loosley

Dominion Foundries and Steel Limited

Mr. W. Samuel

Steep Rock Iron Mines Limited

Mr. R. J. Traill

Dominion Dept. of Mines and Technical  
Surveys

Mr. D. G. Watt

Hydro-Electric Power Commission

Dr. G. E. Willey

Algoma Steel Corporation Limited

Mr. R. B. Young

Hydro-Electric Power Commission

Mr. T. H. Air

Atlas Steel Company

(Co-operating)

Prof. G. Letendre (Co-operating)	Laval University
Mr. J. S. McMahan (Co-operating)	Steel Co. of Canada, Limited
Mr. N. F. Parkinson (Co-operating)	Ontario Mining Association
Dr. Norman Parlee (Co-operating)	Dominion Steel and Coal Co.

Meetings: May 2nd, 1949, 43 Queen's Park, Toronto.  
March 20th, 1950, 47 Queen's Park, Toronto.

### Geology:

Prof. G. B. Langford (Chairman)	Geological Sciences, University of Toronto
Mr. J. O. Gorman	Hydro-Electric Power Commission
Prof. J. E. Hawley	Mineralogy, Queen's University
Dr. D. F. Hewitt	Ontario Dept. of Mines
Mr. M. E. Hurst	Ontario Dept. of Mines
Dr. H. S. Scott	Physics, McMaster University

### Non-Ferrous Metallurgy:

Dr. C. R. Whittemore (Chairman)	Deloro Smelting and Refining Co. Limited
Dr. O. W. Ellis	Ontario Research Foundation
Dr. G. S. Farnham	International Nickel Co. of Canada Limited
Mr. W. M. Goodwin	Bureau of Mines
Mr. L. J. Lichty	Ventures, Ltd.
Dr. L. M. Pidgeon	Metallurgical Engineering, University of Toronto
Mr. M. J. Tamplin	Falconbridge Nickel Mines

### SOILS

#### Main Committee:

Dr. H. B. Speakman (Chairman)	Ontario Research Foundation
Mr. L. J. Chapman	Ontario Research Foundation
Mr. G. Angus Hills	Ontario Dept. of Lands and Forests
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Dr. A. Leahey	Dominion Dept. of Agriculture
Prof. F. F. Morwick	Ontario Agricultural College
Dr. E. F. Palmer	Ontario Dept. of Agriculture

Prof. D. F. Putnam  
Mr. A. H. Richardson  
Prof. G. N. Ruhnke  
Mr. J. Walter  
Mr. F. L. Peckover  
Prof. W. L. Sagar  
Prof. J. W. B. Sisam  
Prof. E. H. Garrard

Geography, University of Toronto  
Ontario Dept. of Planning and Development  
Ontario Agricultural College  
Ontario Dept. of Highways  
National Research Council  
Civil Engineering, University of Toronto  
Forestry, University of Toronto  
Bacteriology, Ontario Agricultural College.





**RESEARCH COUNCIL OF ONTARIO**

**Annual Report - 1951**



# RESEARCH COUNCIL OF ONTARIO

## *Third Annual Report*

1950 - 1951



ONTARIO

TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

Department of Planning & Development  
880 Bay St.,  
Toronto, Ont.  
July 26th, 1951.

TO THE HONOURABLE RAY LAWSON, O.B.E.,  
Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to Your Honour the  
Annual Report of the Research Council of Ontario for the year ended  
March 31st, 1951.

Respectfully submitted,

WILLIAM GRIESINGER,

Minister



Research Council of Ontario,  
39 Queen's Park Cres.,  
Toronto 5, Ont.

July 26th, 1951.

The Honourable William Griesinger,  
Minister of Planning & Development.

Sir:

I present herewith the Report of the Research Council of Ontario for the year April 1, 1950 — March 31, 1951. It consists of a summary of the work of the year by the Director of the Council, and detailed statements by the Chairmen of the various advisory committees. The lists of the personnel of these committees, as appended to this report, are an impressive indication of the active interest and co-operation which the Research Council of Ontario has elicited from scientists and industrialists throughout the Province. The work is broadly based on co-operative effort. It is a great tribute to the Director that he has been able to secure the unqualified support of so many men in science and in industry in the furtherance of the objectives for which the Council was established.

As this is the last report which I shall have the honour to present, I wish to take the opportunity to express my personal indebtedness to the Premier and to the Minister under whom we serve for their unfailing interest in the work of the Council. We have been greatly encouraged by their support. And to me it has been not only a pleasure, but an honour, to have been associated with the men whom the Government nominated as my colleagues in the Council. That association will remain for me a very happy memory.

Respectfully submitted,

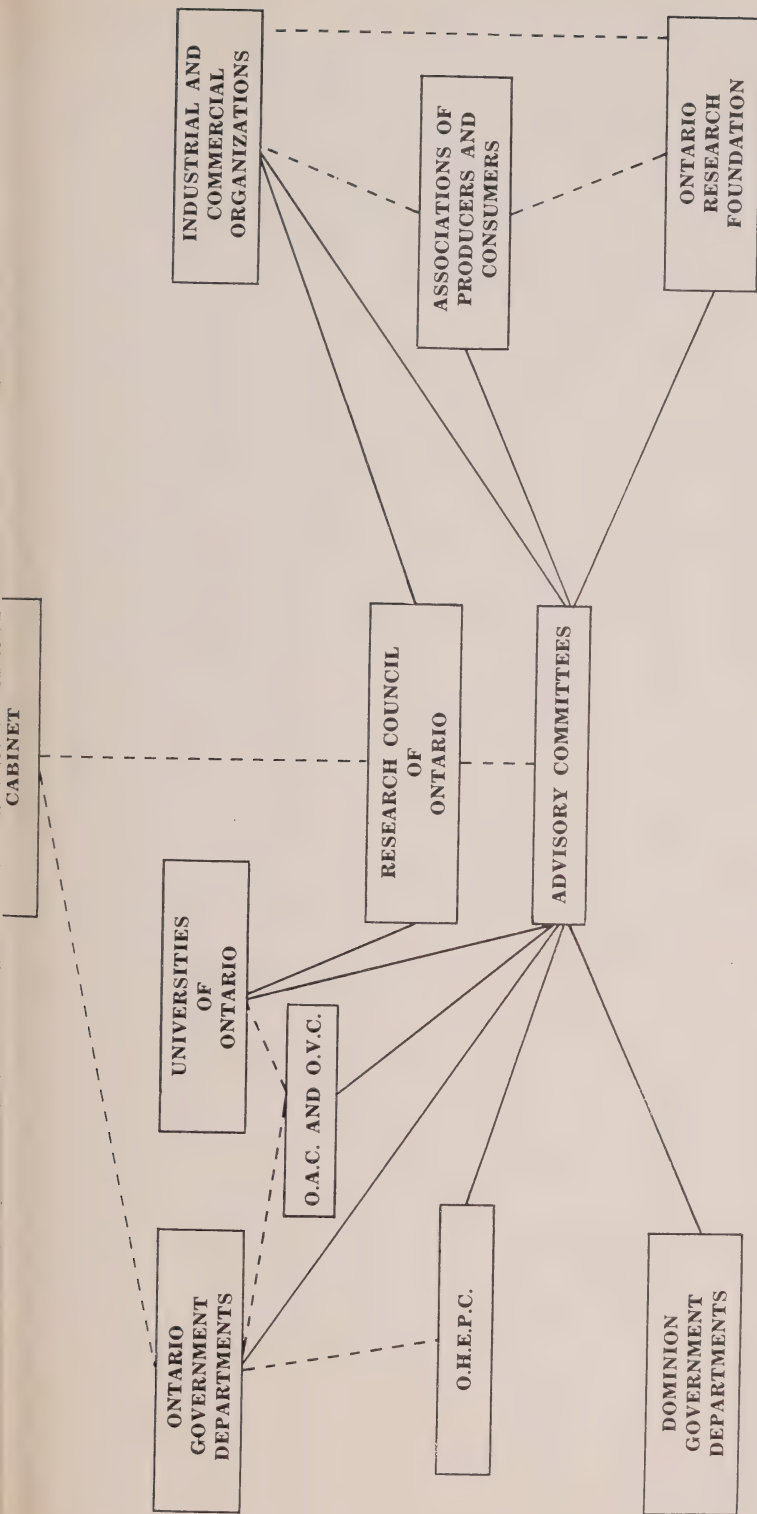
ROBT. C. WALLACE,

President.



### A SCIENTIST ENGAGED IN RESEARCH

The examination of an X-Ray diffraction pattern of spruce needle oil to identify camphor. One of the steps in the research being done on the problem of the extraction of essential oils from the needles of Canadian evergreens. (See page 22)



RESEARCH CO-ORDINATION IN ONTARIO

## Research Co-ordination

Other Organized Relationships-- -- -- -- --





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## RESEARCH COUNCIL OF ONTARIO

Dr. R. C. Wallace .....	Principal, Queen's University, Kingston.	195
(President)		
Dr. R. K. Stratford .....	Scientific Adviser, Imperial Oil Limited, Sarnia	195
(Vice-President)		
Dr. G. P. Gilmour .....	President, McMaster University, Hamilton.	195
Dr. E. Holt Gurney .....	Chairman of the Board, Gurney Products Limited, Toronto.	195
Dr. G. E. Hall .....	President, University of Western Ontario, London.	195
Mr. Hugh Lawson .....	Vice-President and Director, York Knitting Mills, Limited, Toronto.	195
Col. W. E. Phillips .....	1200 Bay St., Toronto	195
Prof. G. N. Ruhnke .....	Director of Research, Ontario Dept. of Agriculture, Guelph.	195
Dr. Sidney E. Smith .....	President, University of Toronto, Toronto.	195
Mr. H. M. Turner .....	President, Canadian General Electric Co. Ltd., Toronto.	195
Dr. C. R. Young <sup>1</sup> .....	72 Roxborough Dr., Toronto	195
Dean K. F. Tupper <sup>2</sup> .....	Faculty of Applied Science & Engineering, University of Toronto, Toronto.	195

### Director

J. O. Wilhelm ..... Research Council of Ontario, Toronto.

### Meetings:

May 1st, 1950, University of Western Ontario, London.

May 2nd, 1950, Sarnia.

August 17th, 1950, 39 Queen's Park, Toronto.

November 18th and 19th, 1950, General Brock Hotel, Niagara Falls

March 9th, 1951, Royal York Hotel, Toronto.

1. Resigned August 17th, 1950.

2. Appointed September 21st, 1950.

## Executive

Dr. R. C. Wallace ----- (President)	Principal, Queen's University, Kingston.
Dr. R. K. Stratford ----- (Vice-President)	Scientific Adviser, Imperial Oil Limited, Sarnia.
Dr. E. Holt Gurney -----	Chairman of the Board, Gurney Products Limited, Toronto.
Dr. G. E. Hall -----	President, University of Western Ontario, London.
Dean K. F. Tupper -----	Faculty of Applied Science & Engineering, University of Toronto, Toronto.

## Meetings:

April 12th, 1950, 39 Queen's Park, Toronto.

## Scholarship Committee

Dr. R. C. Wallace ----- (President)	Principal, Queen's University, Kingston.
Dr. G. E. Hall -----	President, McMaster University, Hamilton.
Dr. G. P. Gilmour -----	President, University of Western Ontario, London.
Mr. Hugh Lawson -----	Vice-President and Director, York Knitting Mills, Limited, Toronto.
Prof. G. N. Ruhnke -----	Director of Research, Ontario Dept. of Agriculture, Guelph.
Dr. Sidney E. Smith -----	President, University of Toronto, Toronto.
Dean K. F. Tupper -----	Faculty of Applied Science & Engineering, University of Toronto, Toronto.
Dr. H. B. Speakman ----- (ex officio)	Director, Ontario Research Foundation, Toronto.

## Meetings:

March 8th, 1951, Royal York Hotel, Toronto.

## Committee on Pollution of the Spanish River

Dr. R. K. Stratford ----- (Chairman)	Scientific Adviser, Imperial Oil Limited, Sarnia.
Dr. E. Holt Gurney -----	Chairman of the Board, Gurney Products Limited, Toronto.
Dr. H. B. Speakman -----	Director, Ontario Research Foundation, Toronto.





## DIRECTORS' REPORT

The preparation for and assistance in the conduct of meetings of advisory committees and their sub-committees occupied much of the time during the year. About thirty meetings were held outside the City and almost daily meetings in the office. The meetings were mainly in Ontario but involved attendance at some in Vancouver, Montreal and other points as well. The secretarial work in connection with the committees of the Council is done in the offices of the Council.

During the year three formal lectures were given: University Women's Club, Oshawa, on April 12th, 1950, Institute of Public Administration, on September 16th, 1950, School of Aviation Medicine, on November 8th, 1950. Informal talks have been given by the Director at many association meetings.

Consultation with scholarship students continues to be an important part of the work of distributing scholarships. Visits were made in this connection to the Ontario universities, and as opportunity offered to universities outside of Ontario. Discussions with professors and research students regarding Research Council policies for scholarships and their administration maintain interest and assure the support of the research worker in this phase of the Council's work.

More and more time is being spent with the supervisors of the various research projects which are being supported by grants in aid from the Research Council funds. Much of the work is resulting in scientific papers. The criterion for assessing the value of the scientific work continues to be the acceptance of reports by the editorial committees of recognized scientific journals. An increasing number of the scientists who have worked on Research Council projects are being employed in Canada in government services, universities and industry.

Meetings of the Council were held in Niagara Falls in November and in Toronto in March. The autumn meeting at Niagara Falls was largely concerned with policy and a general review of the budget for the ensuing year. The meeting in March was devoted to reports from the chairmen of the various advisory committees and discussion with them of the highlights of the work of the committees. This meeting was of particular importance in co-ordinating the general activities of the various committees. A meeting of the Executive was held in April.

The main body of the Annual Report contains reports of the work of the nine advisory committees as prepared by the Chairman of the committee. The main topics of the committee work are reviewed here in a general way.

The Fisheries & Wildlife Committee has been occupied this year with three main activities:

(a) The establishment of a sound policy for the conduct of the biological field stations in order to ensure the co-ordination management and fundamental research. The progress of this co-ordination is shown in the development of the laboratories at Maple, South Bay, Algonquin Park Eriau, etc.

(b) One of the most useful factors in the co-ordination of Fisheries and Wildlife Research in the Province has been the Technical Session which forms a part of the winter meeting of the Committee. The Technical Session is coming to be a useful means for the presentation and criticism of the research work being done in Ontario.

(c) Considerable time was spent during the year on the problem of presenting research results in the best form for those who might apply them. This problem is of special interest to the Research Division of the Department of Lands & Forests.

The Forestry Committee has been active both as a main committee and through its various sub-committees. It has been a useful medium for maintaining contact between the work being done in the Division of Research in the Department of Lands and Forests and research in the universities and in industry. Two main meetings were held, one in Cornwall where discussions were directed toward use of wood as a chemical, and the other in Toronto at which discussions were largely devoted to co-operative research on a regional basis. The problem of establishing the best silvicultural practice to provide a sustained yield continues to be one of the major problems before the Committee.

Sound progress has been made in co-operation with the Forest Products Laboratory in the development of mechanical engineering research on saw milling, both fundamental and applied, and on other equipment related to wood harvesting, forest protection, etc.

In addition to a number of projects of a more general nature the Mines, Minerals and Metallurgy Committee has been active in supporting research on ferrous metallurgy and improvement of basic knowledge in the manufacture and use of wire ropes. This work is centred in the Division of Engineering and Metallurgy in the Ontario Research Foundation.

The Soils Committee, though it has not met formally as a committee has shown continued progress. The work on the physiography of Southern Ontario was completed and the book and maps prepared for publication. General studies have continued in the field of soil microbiology. Additional work is going forward in the application of climatology to the study of soils.

The Highways Committee has been active during the year. The main research is being done in the Department of Highways laboratories. Much of the preliminary work which has been the concern of the Committee

over the past three or four years is now at a stage where some specific projects can be undertaken.

The Industrial Waste Committee has continued its work on milk waste and is doing preliminary studies on a similar problem in canning waste. Much of the work of the Committee is in the application of known facts.

The Industrial Research Committee has been mainly concerned in the supervision of work being done by the Industrial Research Services Division of the Ontario Research Foundation. A much wider and more fundamental interest in the application of industrial research to the general improvement of industry in the Province is being developed.

The Agricultural Committee has not met formally. This has been due to the fact that a strong committee has been working directly with the Department of Agriculture and the Ontario Agricultural College on the whole organization of agricultural research, extension, and education within the Province. Their report will clarify the situation and the co-ordination of research in Agriculture will later be considered.

The Aerial Survey Committee has been active in development work in the fields of photography and photogrammetry. Contact is maintained with workers in the same fields in Ottawa and the United States. The blind landing device developed for use in forestry aircraft has been undergoing service trials. It is being installed in other aircraft for more extensive use.

The support in carrying out the work of the Council received by the Director from the Minister, the President, the members of Council, and a host of research workers has been very pleasant.

The administrative offices of the Council occupy quarters with the Ontario Research Foundation. The close daily contact between the two organizations provides a valuable addition to the Council's work. Dr. Speakman and the members of his staff have been very helpful at all levels of the Council's work.

## ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE

Chairman: Prof. J. R. Dymond

Research in fisheries and wildlife differs in two important respects from that carried out under the auspices of most of the other committees of the Council. The first is that information arising from research in fisheries and wildlife is applied by the Government rather than by industry. This means that group research in which industry and the Council share jointly in the cost is largely out of the question. The second respect in which fisheries and wildlife research differs from industrial research is that so much of it is carried out in universities chiefly by graduate students under the direction of senior staff members.



A picture of the nature and extent of research in this field is given by an analysis of the papers presented before the fifth annual Technical Session held under the auspices of the Advisory Committee on Fisheries and Wildlife at the University of Western Ontario on February 23rd and 24th. At these Technical Sessions reports on most of the research projects under way in the Province are presented by those actually doing the work.

Of the 37 papers presented at the London meeting, 23 were on aquatic biology, 6 on terrestrial biology (wildlife), 3 on parasitology (11 of these had wildlife applications) and 5 on botany (2 of these were on forestry problems). Of the persons presenting the papers, 15\* were students of the University of Toronto, 4 Toronto staff members, 4 students of Queen's University (2 in botany), 3 University of Western Ontario students, 2 McMaster students and 2 McMaster staff, 2 Ontario Research Foundation staff, 7\* Ontario Department of Lands and Forests staff and 1 miscellaneous. Support for the 37 persons carrying on the research was provided as follows: Research Council of Ontario 16 (2 under Forestry Committee), National Research Council 5, Fisheries Research Board of Canada 2, Ontario Department of Lands and Forests 8, Ontario Research Foundation 2, and miscellaneous 4.

Research by students and other university personnel has a number of advantages. Besides providing new knowledge it provides training in research for those from whose ranks the staffs of government and other research organizations are recruited. It is relatively inexpensive since students working towards a degree receive less remuneration than full time personnel employed by research organizations. The research is usually of a basic or fundamental nature.

Research on problems of immediate practical importance in the administration of our fisheries and wildlife resources has not been adequately developed. University research cannot undertake the investigation of most problems in this field since they usually require for their solution not only observations over a longer period of years than a graduate student can devote to them but involve observations throughout the entire year. Most students can carry out field work only in summer. Until Government fisheries and wildlife laboratories can be increased in numbers and more adequately staffed with full time research personnel the information necessary as a basis for fisheries and wildlife management will continue to be quite inadequate.

The Committee has recommended the following as a basis for the creation and operation of laboratories for the study of Great Lakes fisheries problems on a co-operative basis.

The agencies whose co-operation should be sought are the Ontario

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\* Three were graduate students employed by the Department of Lands and Forests.



Department of Lands and Forests, the Fisheries Research Board of Canada, the Universities and industry.

In the opinion of the Committee, the initiative and leadership in Great Lakes research should be assumed by the Research Division of the Department of Lands and Forests. Laboratories should be constructed and operated by this Division. Personnel working in such laboratories should consist of—

1. One or more scientists employed by the Research Division. The Director of the laboratory should be an employee of this Division.
2. Visiting scientists and students from universities.
3. Scientists employed by the Fisheries Research Board.
4. Occasional visiting scientists from other institutions.
5. A district biologist or other investigators of the Fish and Wildlife Division of the Ontario Department of Lands and Forests.

The research programme or programmes to be carried out in the Great Lakes laboratories should be determined through consultation among the agencies having workers at the stations.

Research by personnel supported by an institution should be considered as a programme of that institution but each should constitute part of one integrated programme.

In general the programme of the Department of Lands and Forests should be in the field of applied research whereas the universities' programmes should be more fundamental or basic.

It is hoped that the fishing industry will co-operate through supplying specimens and information, making records, loaning gear or personnel, and in many other incidental ways.

It is expected that the first laboratories will be provided on those lakes having the most important fisheries or where administrative problems are most acute.

Until other Committee or Committees are set up it is suggested that the Executive of the Advisory Committee on Fisheries and Wildlife of the Research Council of Ontario together with a representative of the fishing industry act as a committee to integrate the work of any Great Lakes stations that may be established.

Parasitology and diseases of wildlife is another field in which much more research is needed. Although the Ontario Research Foundation with the support of the Research Council of Ontario is carrying on an excellent programme and the Royal Ontario Museum of Zoology has started to develop a collection of external parasites, these efforts, excellent as they are, are quite inadequate in view of the importance of parasites and disease

as factors in affecting wildlife. Besides affecting the size of wildlife populations, diseases of wild animals have a relation whose importance is little known to the health of domestic animals and of man himself. Some diseases common to wildlife, domestic animals and man include equine encephalitis, rabies, tularaemia, trichinosis and hydatid disease. The full extent to which wild animals serve as reservoir hosts of parasitic organisms that may infect man and his domestic animals is very imperfectly known.

A subcommittee of the Advisory Committee on Fisheries and Wildlife is making a special study of problems involved in parasitology and the diseases of wildlife and has recently submitted a list of research projects considered of importance. This list includes researches of immediate practical importance as well as those of a long-term fundamental nature. At the top of their list they place taxonomy and the need for determining the normal blood picture of wild animals. Taxonomy, or identification and classification is basic to every other phase of the study of any organism. The difficulty or impossibility of getting several groups of parasites properly identified is interfering seriously with other phases of parasitology.

Until we know the normal blood picture of wild animals, the recognition and study of abnormal conditions is impossible. Greatly increased support of research in parasitology and the study of animal diseases is strongly urged by the Committee.

### Reports:

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- "Are *Leucocytozoon sakharoffi* Sambon and *Leucocytozoon berestneffi* Sambon Synonymous?" A. M. Fallis, Canadian Journal of Research D28: 1-4, 1950.
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- "Toxic and Allergic Manifestations Caused by Tissues and Fluids of *Ascaris* Part II. Effect of Different Chemical Fractions on Worm-free, Infected, and Sensitized Guinea Pigs". J. F. A. Spret, Journal of Infectious Diseases, 86: 146-158, 1950.
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- "The Lake Erie Cisco Population: Fluctuations of Abundance". W. B. Scott, Contributions of the Royal Ontario Museum of Zoology, No. 32.
- "Lake Erie Ciscos Free of *Trienophorus crassus*". W. B. Scott, Canadian Field Naturalist.
- "Experimental Rearing of Yellow Pike-perch in Natural Waters". W. B. Scott, D. M. Omond and G. H. Lawlor, Canadian Fish Culturist.
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- "Plants Collected in the Dundas Marsh, Hamilton, Ontario, 1946". W. W. Judd, Canadian Field Naturalist, Vol. 65. 1950.
- "Mosquitoes Collected in the Vicinity of Hamilton, Ontario, During the Summer of 1948". Mosquito News, Vol. 10, No. 2, June, 1950.
- "A Comparison of the Effects of Several Concentrations of Oxgall in Platings of Soil Fungi". J. J. Miller, D. J. Peers, and R. W. Neal, Canadian Journal of Botany, 29: 26-31, February, 1951.

## ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Dean J. W. B. Sisam

### Introduction

During 1950 the Advisory Committee on Forestry Research held two meetings, the first on April 14th in Toronto and the second on September 7-8th in Cornwall where members had the opportunity of visiting the plants of Howard Smith Paper Mills Ltd. and Courtauld's (Canada) Ltd.

Apart from those projects that have been continued from previous years, the matters with which the Forestry Committee has been most concerned during 1950 have to do first with afforestation and woodlot management in Southern Ontario, and second, with recent progress and possible new lines of development in the field of wood chemistry.

Before discussing these matters in any detail, some reference should be made to the present status and plans for the future of some of the more important projects that are on a continuing basis.

### Sawmilling

As pointed out in earlier reports, two surveys have been made of present-day sawmilling machinery and equipment in Eastern Canada, one having to do largely with machine design was undertaken on the recommendation of the Advisory Committee on Forestry, while the second was made by the Forest Products Laboratory at Ottawa and was concerned in the main with statistics of production and wood waste. Final reports on the first of these surveys have been issued and a report on the second will be available shortly.

The results of these surveys indicated the need for a comprehensive study of sawmill machinery with the object of increasing its efficiency, and

the Advisory Committee recommended to the Research Council of Ontario that support be given to such a research programme to be developed co-operatively with the Forest Products Laboratory at Ottawa.

Progress in this work is reported as follows:

1. A building to house a research sawmill is now ready at the Laboratory in Ottawa and the mill itself will be installed in April and should be ready for operation early in the summer. The instrumentation of this mill will make it possible to carry out tests with adequate control over such variables as power, speed and the stresses set up in operation.

2. The direct interest of the Council in this project at the present time is mainly in the work of members of staff of the Department of Mechanical Engineering, University of Toronto, who are assisting in the setting up and instrumentation of the research mill and are investigating specific engineering problems related to this project.

3. As a further step in this undertaking it is proposed later on to establish a pilot mill to demonstrate, among other things, the economic feasibility of the findings of the research mill. At present, consideration is being given to the most suitable type of mill for this purpose and the best site for its establishment. Two areas that have been suggested are the University of Toronto forest near Dorset and the Petawawa Forest Management Unit of the Department of Lands and Forests.

It is of interest to note that Nova Scotia is interested in this programme and that the Forest Service and Nova Scotia Research Council are planning to co-operate in the establishment of a pilot mill along the same lines we have in mind in Ontario.

### Utilization of Sawmill Waste

A high proportion of the wood content of sawlogs is burned or discarded in the form of slabs and edgings. It would seem logical that the wood content of this waste material could be used in pulping and other chemical processes. For the Province as a whole a large proportion of this material is produced by small mills often a considerable distance from pulp mills or other manufacturing units that might make use of it. This is one aspect of the overall problem of integrated utilization to which reference was made in last year's report.

Under present conditions the main problems affecting the use of this material are to develop an efficient means of removing and separating the bark and preparing the material for further manufacture (e.g. chipping), and improvement in methods of handling and transportation.

In 1947, on the recommendation of the Advisory Committee, a study was made by Professor I. W. Smith of the Department of Mechanical Engineering, of mechanical methods for the removal of bark from waste



material. Professor Smith's report was widely circulated to many interested companies and individuals.

It is apparent that a problem of this sort is of general interest to the industries concerned and by no means provincial in scope. Following discussion between representatives of our Advisory Committee and Col. J. H. Jenkins, Chief, Forest Products Division, Ottawa, a co-ordinating committee is being organized by Col. Jenkins to study for Eastern Canada as a whole, the problems involved in the mechanical barking, handling, and transportation of mill waste for use as pulpwood. Our Advisory Committee will be represented in these discussions and it is recommended that the Research Council of Ontario continue to support the project, particularly in the study of problems affecting the mechanical barking of wood waste.

### **Forest Regeneration**

The problem of obtaining adequate reproduction of our commercially important forest tree species has been set out in earlier reports. It is generally true to say that any regeneration that becomes established after present-day logging operations is incidental and bears no particular relation to the method of cutting used. As a result, there are extensive areas of forest land, often of good quality, that remain unproductive for years, while on other sites we are often growing at an accelerated rate kinds of trees that we do not particularly want, but which have been left after removing the present merchantable species. Under these conditions the quality of much of our forest is deteriorating, and our timber front is receding with a resulting increase in cost of wood delivered at the mill.

The first need in this regard is to have dependable information on the extent and quality of regeneration on our cut-over areas. On the recommendation of the Advisory Committee Professor R. C. Hosie of the Faculty of Forestry has been investigating this situation over the past two years. The field work is now completed and a report will be presented at the next meeting of the Advisory Committee, to be held at Kapuskasing in May. At that time, Professor Hosie's findings and recommendations will be fully discussed by members of the Committee and illustrated with reference to conditions in the pulpwood stands of the Clay Belt. Following this, the final report will be prepared and submitted for publication in the fall of 1951. This report will undoubtedly provide the necessary information from which to determine our present position and the most urgent problems requiring attention, and also to aid the administration in formulating regulations to implement its policy of sustained yield management.

### **Wood Chemistry**

In the manufacture of sulphite pulp approximately 50 per cent of the wood is discarded as lignin and other organic materials in the form of waste sulphite liquor. Possible means of utilizing this waste material has been the subject of a great deal of research. A bibliography of the relevant

literature covering the period 1943-49 has been prepared by Dr. H. B. Marshall, Chairman of the Wood Chemistry Sub-Committee. This was issued in June, 1950, and approximately 300 requests for copies have been received from laboratories and libraries in Canada, United States, and foreign countries. It is now proposed to continue this bibliography on an annual basis and the first addendum to the Report for the year 1950 was published in the February, 1951, issue of the Pulp and Paper Magazine of Canada.

During the past year there has been a very appreciable increase in the number of students carrying out research in wood chemistry in the universities of Ontario. Some of these students are receiving financial support from the Research Council of Ontario on the recommendation of the Forestry Committee. However, the percentage is still comparatively small and further efforts will be made by the Sub-Committee to stimulate greater interest in Wood Chemistry at the universities wherever possible.

During the year the Wood Chemistry Sub-Committee has continued to supervise four research projects which are being carried out at the Ontario Research Foundation under the sponsorship of the Research Council. The results of this work are being made available to industry through scientific publications, articles in trade magazines and lectures. Progress in these four projects may be summarized as follows:

1. **Essential Oils.** A study of the essential oils from the foliage of spruce, hemlock and balsam has been completed and that of cedar is in progress. When the latter is completed, the project will be terminated since the yield of oil from other species is much lower and therefore not considered practicable on a commercial scale. Considerable interest has already been shown in the results obtained with spruce needle oil and at least one operator is investigating the use of portable distillation units. To indicate the possibilities it may be mentioned that in the case of black spruce there are some 540 million pounds of foliage available in Ontario annually which represents a potential yield of 5 million pounds of spruce needle oil, or about 5 lbs. of oil from the foliage associated with one cord of wood.

2. **Hardwood Utilization.** A fundamental study of the effect of hemicelluloses on the papermaking properties of white birch has been completed and reported. This is being supplemented at the present time by a study of methods of pulping white birch which will retain the optimum percentage of hemicelluloses necessary to produce pulps comparable to those from softwoods.

3. **Waste Sulphite Liquor.** Considerable progress has been made on the separation of the sugar constituents in waste sulphite liquor by means of paper partition chromatography. At least ten different carbohydrates have been isolated. These materials are of considerable interest from a fundamental point of view but their industrial importance may be limited.

4. **Tanning Agents from Waste Sulphite Liquor.** A fundamental

study of the tanning properties of waste sulphite liquor has been completed and these results will be reported in the near future as a scientific publication. This work has indicated that lignin is lacking in certain properties in order for it to function as a satisfactory tanning agent. Attempts have therefore been made to modify lignin chemically in order to overcome these defects, with very satisfactory results. At least one modification appears to have tanning properties equivalent to those of the natural tannins while another can be blended with 25% of the natural tannins to give equivalent results. Since Canadian tanners import 99% of their tanning materials, this project is considered to be extremely important from a defence point of view and the programme will be speeded up as soon as possible.

### Afforestation and Woodlot Management in Southern Ontario

To anyone who has travelled through Southern Ontario it must be apparent that there is much idle land that is not contributing anything to our economy—land that once bore valuable stands of timber was cleared for agriculture and has since been found unsuitable for that purpose—the result of an early policy in this country that all land should be cleared for cultivation and settlement. Even during the past fifty years this trend has continued and the proportion of wooded land in Southern Ontario has dropped from 16 to 9 per cent. However, the tide has now turned and submarginal farm land is rapidly being abandoned.

There are a number of reasons why much of this land should be returned to timber as quickly as possible:

1. This would be the highest form of land use.
2. Under proper management, large volumes of commercial species would be readily accessible to markets.
3. Afforestation should, in many cases, have beneficial effect on soil stabilization and the regulation of stream flow.

In this connection it may be noted that the Report of the Royal Commission on Forestry (1947) suggests that at least 2,500,000 acres, and probably more, might profitably be reforested in this region.

Over Southern Ontario as a whole there is a wide variety of soil conditions, some on which trees may readily be established and some where this is not so true for one reason or another. These latter sites would, however, be much better under forest than as they are, whether it be from the viewpoint of local wood production, prevention of soil erosion or better regulation of water levels.

In reports issued during the past few years by two authoritative groups set up by the Provincial Government, the Royal Commission on Forestry and the Select Committee on Conservation, it was strongly recommended that research be undertaken on the method and species best suited to the



afforestation of difficult sites in Southern Ontario. Members of the Advisory Committee have gone into this matter in some detail and will present, at our next general meeting, definite proposals for such an investigation.

Of the existing woodland in Southern Ontario, it has been estimated that not more than 10 per cent could be classified as good forest. There appear to be a number of reasons for this situation. The problem of marketing woodlot produce was mentioned in an earlier report. This matter has been given further consideration by the Advisory Committee and it is felt that as it is largely a question of fact finding and market promotion, it is not within our terms of reference. It is being given attention by the Department of Lands and Forests so far as staff and time will permit.

There is, however, another problem affecting the economics of management of small privately owned woodlands that requires investigation—that is the problem of taxation, with particular reference to the property tax as legislated for under the Ontario Assessment Act. Among other points, it may be noted that, at the present time, the farmer pays an annual tax on his trees as part of his property and woodlands may be assessed as much as \$75.00 per acre. If the trees are completely removed, reassessment may be for as little as \$2.00 per acre. In other words, the crop is being taxed rather than the crop-producing nature of the land, as is generally the case for agriculture. Both the very high and very low assessments have a bad influence on forestry practice, the latter because it permits forest land to be utilized for low-grade pasture or left in idleness or near-idleness.

The assessment pattern varies a good deal throughout Southern Ontario and there are a number of local factors affecting this general problem. It has been recommended by the Canadian Institute of Forestry that a study of forest taxation in Southern Ontario be undertaken and this recommendation has the support of the Advisory Committee. Other groups that would be actively interested in such a project are the Department of Lands and Forests, the Provincial Department of Agriculture and the Federal Tax Commission. It is proposed to develop this as a thesis problem for a graduate student in forest economics, his work to be under the supervision of the Faculty of Forestry in consultation with a committee representing the various interested groups that have been mentioned.

## Reports

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- "Sawmilling—Report on Small Sawmilling Equipment Dealing Specifically with Edgers, Trimmers and other Auxiliary Equipment." W. G. McIntosh, J. W. Church, R.C.O. Report No. 4-1-50, April, 1950.

## ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: Mr. C. A. Pollock

### Industrial Research Services

The report for the 1950 calendar year was presented at the February meeting of the Committee. This showed remarkable progress in the Department of Industrial Research Services since 1947. In 1949-50 new jobs handled increased by 22½%; repeat jobs increased 31%. In the three years 1948, 1949 and 1950, repeat clients increased two and a half times.

The staff now includes seven engineers. The Committee met these young men at one of the regular meetings, and have met them individually out in the field. This year the department's activities have widened to include the Head of the Lakes and the Eastern Townships.

There has been some outside recognition of the work of the Industrial Research Services Department. A representative of the United States Department of Commerce paid a visit in order to observe the method of operating. There has also been contact with organizations in the United Kingdom.

### Group Research

It is difficult to get industrialists to collaborate in group research. Good work has been done in promoting the idea, but development has been slow. The Committee held one meeting at Milton to see the sponge iron operations there which had been done as a group project. The report on the canning project indicates good results. A new project on electroplating is under way, and the heating and ventilating industry is considering a project. Further efforts have been made to interest the leather industry, but so far results have not been very satisfactory. Projects in the wood working field, the textile field and the washing machine field are also being considered.

### Co-operation with the Canadian Manufacturers' Association

At the Annual Meeting of the Canadian Manufacturers' Association in June, 1950, an Industrial Research Session was included. The Committee was given the opportunity of co-operating by arranging for the

papers that were presented at the opening session. These reports were published in "Industrial Canada".

## Publicity

The Publicity Committee has developed a direct mail promotional approach to interest manufacturers in research work and the Industrial Research Services. This is an experiment which is being given close attention by the whole Committee.

In the communities in which members of the Committee are located, arrangements have been made for speaking engagements for the Director and members of the staff of the Industrial Research Services. Field representatives have also been introduced to the business men of the community. Chambers of Commerce and Boards of Trade have co-operated in this, and close liaison has been maintained with the Trade and Industry Branch of the Department of Planning & Development.

A booth was set up at the Canadian National Exhibition, with the idea of relating research to the things that go on in every day life.

## Patents

Some investigations have been made on the possibility of obtaining patents which may result from research work.

## Future Plans

It is the Committee's feeling that the first job is to spread the understanding of the need of research to industries in Ontario. The work of the Department of Industrial Research Services plays an important part in demonstrating to industry, large and small, the value of research, both from the point of view of individual research projects and group research.

The Committee has helped interpret the thinking and attitudes of business to the men who are in charge of research and helped them in contacts with industry. At present the job is more important than it has ever been. With the influx of immigration and small companies starting up, it is important to establish the need for research in the minds of the managers of the smaller companies. There is also the preparedness program for war and civilian needs.

## ADVISORY COMMITTEE ON MINES, MINERALS AND METALLURGY

Chairman: Mr. N. F. Parkinson

### Ferrous Metallurgy

Trial runs to produce sponge iron from Canadian iron ores, utilizing existing brick kilns, and financed jointly by the steel industry in Canada and the Ontario Government through funds provided by the Council,

were completed in 1950. These runs resulted in a satisfactory product and demonstrated conclusively that in times of urgency shortages of scrap could be overcome to the extent of kiln capacity available. The product from the test runs was all consumed in the ordinary course of their operations by some of the steel companies here in Ontario. Costs, while barring the method in competition with good scrap in ordinary times, did not indicate any great handicap to its use under emergency conditions. Much useful information on details of equipment and operational methods was obtained, and it seems certain that the industry and the Government must feel that the activity was well worthwhile, with the results of particular importance in these times.

In some countries where coal is scarce and labour is cheap the process offers economic prospects immediately. The committee's report, released with the consent of the Provincial and Dominion Governments, has already brought requests from several of these for detailed information and permission to use the method.

The work carried on towards the development of a pelletizing method has had some practical results. One commercial extrusion plant with a capacity of some 20 tons per hour is already operating at Warton and another at Cleveland, Ohio. A number of pilot test plants are also in operation.

During the year Mr. Cavanagh was sent to Paris to attend a discussion on the possible conduct of pilot plant research on the use of the oxygen-fed, low-shaft blast furnace in treatment of certain iron ores, all to be carried out under the auspices of Organization for Economic Co-operation in Europe. The question as to whether or not some of this work should be carried out in Canada is under advisement.

### **Spectrographic Studies**

The work carried out in past years by Dr. Hawley of Queen's University on the use of the spectroscope for qualitative and quantitative determinations of small quantities of important elements or metals in Ontario ores has been continued during the year and is now being applied commercially in at least one mine in the Province.

### **Wire Ropes for Hoisting**

Operations of the wire rope testing machines designed and constructed by the Council have continued during the year on a scale below that which was desired by the Committee but governed in the main by the amount of funds available. Special attention this year was given to the effect of corrosive liquids on the ropes tested for comparison with results previously obtained when corrosive action was not induced.

Council also authorized participation in another joint project, this time with the mining industry. Here Council and the industry are par-

ticipating equally in research designed to determine the applicability of a supersonic or mechanical wave in the detection of defects due to broken wires, corrosion of the wires or kinks, or other weakening causes appearing in ropes in service. Here the Council is making use in part of the testing machine operated for us by the Research Foundation, the Foundation personnel not only co-operating in this activity but lending their services as advisers to the Committee responsible for the program.

## General

More work is also being carried on with respect to temperature gradients in rock, radioactivity of rocks and structures and polarographic analysis of alloys, all on a minor scale.

Without having discussed the matter in Committee, such that the opinion here expressed is advanced as my own, it does seem to me that the provision in the Research Council Act for joint projects by the Council and industry should be encouraged to the point where it may become the most important field of endeavour of the Council. I believe that in that way we can be more assured as time goes on that the work undertaken and the money spent is directly applicable towards the development of the Province's natural resources.

## Reports

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## ADVISORY COMMITTEE ON INDUSTRIAL WASTE

Chairman: Prof. A. C. Plewes

The Industrial Waste Committee has continued its studies in 1950-51 and has been much interested in the installation and testing of two 2,000-gallon, milk waste disposal plants in Ontario. These units were designed by members of the Department of Health Laboratories in Toronto, and the work was financed by a Research Council grant of \$15,000.

The initial pilot plant was to be installed as an anerobic digester at the Rutherford Dairy near Toronto. Co-operation between the owner of the dairy and the Department of Health officials prompted him to bear half the cost of installation and to accept the responsibility of construction. Unfortunately, in November, Rutherford suffered a serious back injury which has delayed the construction and completion of the project. The owner has recovered now and is busy with the installation of the digester. Tests will be made early in 1951.

In the meantime an areobic milk waste digester was also designed and installed in a plant at Jarvis, Ontario. In this case the project was wholly financed by money granted by the Research Council of Ontario. This unit was completed in December, 1951, and has been in operation since that time. The results are still indecisive, but it has been noted that the effluent contains much less fat and undesirable waste before its discharge to the neighbouring streams. A complete test will be made this spring and summer, and it is hoped that data may be obtained in mid-winter when operation is difficult.

During the year Dr. Berry and his associates were also asked to design waste disposal systems for dairies and creameries at ten plants in Ontario. This work was completed and tests have indicated successful operation after installation. At the same time a "Housekeeping Manual" for milk plants has been prepared and will be distributed to operating personnel in the near future.

Considerable laboratory work has also been carried out (with some Research Council of Ontario support) in the Department of Health Laboratory in an effort to learn ways and means of treating plant water containing phenolic and chlorinated phenolic compounds. Companies manufacturing these compounds present serious pollution problems, since these compounds impart bad taste and odor, and destroy marine life.

Chemical studies showed that chemical reagents such as chlorine dioxide can transform the offender into a much more innocuous substance. The matter of cost, however, presents a major problem and that phase is being studied now. The committee plans to contact members of the Canadian International Paper Company to discuss the manufacture of chlorine dioxide at a reduced cost. It is also planned to write Ontario universities and learn whether they were interested in studies concerning the removal of chlorinated phenols from water. If enough interest is shown, the Committee hopes to finance some of these investigations.

For the session 1951-52, \$15,000 has been suggested for the study of the milk waste problem and for a preliminary review of canning factory wastes. This latter problem has become acute in several parts of Ontario, and it is believed that some action should be taken at this time.

## Reports

"Progress Report, Milk Waste Research, November 16, 1949, to October 31, 1950", N. D. Woollings.

"Progress Report, Phenolic Waste Treatment, 1950", R. W. Edmunds, R.C.O. Report No. 7-2-50.

## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Mr. Alan K. Hay

Modern highway development has taken place within a span of less than forty years following the First World War. During that period some attention has been given to the road and the motor vehicle as regards design standards. Because of the economic factor it has been possible to construct only a small proportion of the total highway mileage to a standard which would anticipate improvements in the design of cars. The result is that we now have many miles of highway which were quite adequate for the motor vehicle of a few years ago but which are obsolete in comparison with the cars and trucks now being manufactured.

The public is becoming more thoroughly informed on these matters and is voicing a demand for better highways, improved traffic law enforcement and a more advanced practice in licensing drivers. The following recent developments have also helped to focus attention on highway problems:

1. The recent railway strike and the large part played by the truck and bus transport industry in keeping goods and services moving.
2. The acceptance by the Federal Government of a share in the construction of the Trans-Canada Highway.
3. Statements by those in authority that the continued building and operation of a sound highway system is vital in a defence program.

This general interest in highway problems has already created a more favourable atmosphere towards research projects. As a step in this direction the Canadian Good Roads Association at its annual meeting in Winnipeg last summer went on record as advocating the setting up of a Roads Research Institute on a national scale. Following this the Association has retained Dean Hardy of the University of Alberta to make a preliminary study of the field. The committee hopes to stimulate a greater interest in highway research through university channels. As yet it is not possible to report much concrete progress along these lines.

Worthwhile progress in research is being made by the Ontario Highways Department through Mr. John Walter and his staff. Other than this, research projects are at present largely confined to a few of the large industrial corporations who are interested in improving the production and use of some of the basic materials used in road construction. An outstanding example is the work of Dr. Norman McLeod of Imperial Oil Limited. His investigations into the supporting power of bases for airport runways and highways have received wide publicity in this country and in the United States and his published findings have stirred up a very considerable controversy with some of our American friends.

In October the Committee met in Ottawa, and following the usual business meeting, visited the Building Research Division of the National Research Laboratories as guests of Mr. R. F. Legget, the Director. In the evening, Mr. John Walter delivered a paper before a joint meeting sponsored by the committee and the Ottawa Branch of the Engineering Institute of Canada, his subject being "Frost Action as Affecting the Highway".

## ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

Chairman: Prof. K. B. Jackson

The Advisory Committee held one meeting at Sault Ste. Marie on September 15th and 16th, 1950. A thorough review of projects in progress was made and the program for the future was discussed. The members had an opportunity to visit the Timber Inventory and Survey Section of the Abitibi Power and Paper Company and under the guidance of their chief photogrammetrist, Mr. S. T. B. Losee, a member of the Committee, study their methods of using aerial photographs. Mr. Geo. Ponsford of the Air Service Division, Department of Lands and Forests, arranged for a demonstration of the radio landing aid which has been installed in two of the Division's planes for extended performance tests.

### Progress During the Year

**Radio Landing Aid.** This project and the first experimental unit was described in last year's report. A second unit with slight modifications has since been completed, installed and tested. Specific reports on performance have been satisfactory. The first unit has been similarly modified and a third is ready for installation and further trials.



A description of the instrument appeared in the March issue of "Aviation Age" and as a result, 70 requests for technical details have been received from Canada, the United States, Brazil, Australia, England and France. As the original report is out of print, a second edition is in preparation and will be distributed when available.

**Transparencies and Stereoscopes.** This project has for its aim the determination of the best combination of photographic materials and processes and observing techniques for maximum interpretability. Initial investigations were aimed at justifying the transparency in preference to the ordinary print, but as this involves the use of special stereoscopes or light tables, it was decided to experiment with other methods of printing which, if beneficial, would be applicable to prints and transparencies and would no doubt enhance the admitted advantages of the latter.

Mr. J. R. G. Smyth of the Air Survey Section of the Department of Lands and Forests has prepared an extensive report on experiments with "unsharp masking" and has obtained some very significant results. It is understood that the Photographic Survey Corporation has adopted the "unsharp masking" technique in certain cases for the production of better diapositives for stereoscopic plotting instruments. This work is being continued and an effort is being made to reduce results to relative values of resolving power for purposes of comparison with other investigations.

The design of a stereoscope for transparencies will be resumed when this work is completed.

**Stereoscopic Projection with a "Floating Mark".** A new technique has been developed for the presentation of three-dimensional information by stereoscopic projection incorporating a "floating mark" or pointer which can be precisely adjusted to coincide with any point on the three-dimensional model. This has been described in "Photogrammetric Engineering", March, 1951.

Other projects relating to "bridging" or aerial triangulation, with the Multiplex and Wild equipment have been postponed due to the lack of equipment available for the purpose.

## Reports

"Stereoscopic Projection in Teaching, or 'Is Your Other Eye Only a Spare?'"  
K. B. Jackson. Reprinted from "Photogrammetric Engineering",  
March, 1951.

## ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH ADVISORY COMMITTEE ON SOILS RESEARCH

The committees have not met during the year. Work in these fields is being re-organized. Individual projects are being handled by ad hoc committees.

## Reports

"The Physiography of Southern Ontario" (284 pages) L. J. Chapman and  
D. F. Putnam, University of Toronto Press, 1951.



# APPENDIX I

## STATEMENT OF EXPENDITURE For the Year Ended 31st March, 1951

### ADMINISTRATION:

Salaries .....	\$ 14,860.42		
Maintenance .....	4,561.55		
Travelling .....	4,009.14	\$ 23,431.11	

### SCHOLARSHIPS

47,980.00

### GRANTS AND PROJECTS:

#### Ontario Research Foundation:

Wire Rope .....	\$19,162.54		
Ferrous Metallurgy .....	28,827.87		
Parasitology .....	40,191.93		
Wood Chemistry .....	33,777.00		
Physiography .....	24,600.94		
Utilization of Agricultural Products .....	13,179.84		
Industrial Research Service .....	67,017.01		
Physics of Metals .....	6,156.47	232,913.60	

#### University of Toronto:

Fisheries and Wildlife .....	27,410.00		
Mines .....	4,500.00		
Forestry .....	11,450.00		
Aerial Survey .....	5,000.00		
Supplemental fund .....	4,820.00	53,180.00	

#### McMaster University:

Fisheries and Wildlife .....	9,000.00		
Forestry .....	1,750.00		
Mines .....	1,250.00		
Supplemental fund .....	1,340.00	13,340.00	

#### Queen's University:

Fisheries .....	10,000.00		
Mines .....	4,500.00		
Forestry .....	6,000.00		
Industrial Waste .....	750.00		
Supplemental fund .....	2,370.00	23,620.00	

#### Universities of Western Ontario:

Fisheries and Wildlife .....	10,100.00		
Mines .....	3,150.00		
Supplemental fund .....	1,470.00	14,720.00	

#### Department of Health:

Milk Waste .....	10,133.35	10,133.35	
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#### Department of Lands and Forests:

Forestry .....	11,050.00	11,050.00	358,956.95
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#### GROUP RESEARCH (Government share, 50%)

7,250.34

\$437,618.40

## APPENDIX II

### SCHOLARSHIP AWARDS — 1950-51

Name	Field	Scholarship University	Award
Abel, M. K.	Geology	Queen's University	\$ 600.0
Alexander, J. C.	Biochemistry	Ontario Agricultural College	600.0
Armstrong, H. L.	Physics	Queen's University	600.0
Barrett, I.	Biology	University of Toronto	600.0
Bendell, J. F.	Biology	University of British Columbia	600.0
Bevege, Miss E. E.	Chemistry	Queen's University	750.0
Blackwell, J. H.	Physics	University of Western Ontario	1,000.0
Bowman, R. I.	Biology	University of California	600.0
Carman, G. M.	Biology	Iowa State University	500.0
Chaplin, N. J.	Metallurgy	University of Toronto	600.0
Cook, F. S.	Biology	University of Toronto	600.0
Cranna, N. G.	Physics	University of British Columbia	750.0
Cruise, J. E.	Biology	Cornell University	600.0
Cumming, C.	Physics	University of Toronto	600.0
Duvall, J. M.	Physics	McMaster University	600.0
Eastcott, J.	Mathematics	University of Michigan	600.0
Feldman, G.	Mathematics	University of Toronto	600.0
Gage, R. S.	Biology	Ontario Agricultural College	600.0
George, Miss P.	Chemistry	Queen's University	600.0
Griffiths, G. M.	Physics	University of British Columbia	600.0
Hamilton, D. R.	Physics	University of British Columbia	600.0
Harrower, G. A.	Physics	McGill University	750.0
Horsley, R. J.	Physics	University of Saskatchewan	750.0
Hossack, W. R.	Astronomy	University of Toronto	600.0
Hudson, J. D. H.	Physics	University of Toronto	750.0
Hunt, C. F.	Physics	McMaster University	600.0
Iverson, K. E.	Mathematics	Harvard University	600.0
Johnson, W. E.	Agriculture	University of Saskatchewan	750.0
Love, A. W.	Physics	University of Toronto	1,000.0
McArthur, N. M.	Geography	University of Michigan	900.0
MacAskill, D.	Physics	McMaster University	750.0
McElcheran, D. E.	Chemistry	McMaster University	750.0
		Leeds University (travel grant)	200.0
MacKenzie, I. K.	Physics	University of British Columbia	900.0
McLay, D. B.	Physics	McMaster University	600.0
MacMillan, F. A.	Physics	Queen's University	600.0

Name	Field	Scholarship University	Award
McMullen, C. C.	Physics	McGill University	\$ 900.00
Manson, J. G. A.	Biology	University of Toronto	600.00
Maxwell, Miss D. E.	Biology	McGill University	750.00
Maxwell, J. A.	Geology	University of Minnesota	900.00
Meyers, N. W.	Chemistry	Queen's University	600.00
Page, J. A.	Chemistry	Harvard University	900.00
Pearson, A.	Physics	University of Toronto	750.00
Petch, H. E.	Physics	University of British Columbia	750.00
Rigler, F. H.	Biology	University of Toronto	600.00
Salkeld, Miss E.	Biology	London University	1,000.00
Sharman, L. J.	Physics	McMaster University	600.00
Shoemaker, R. A.	Biology	Ontario Agricultural College	600.00
Smillie, K. W.	Mathematics	University of Toronto	900.00
Standil, S.	Physics	University of Manitoba	900.00
Strickland, K.	Biochemistry	University of Western Ontario	900.00
Szabo, A.	Biochemistry	McMaster University	750.00
Teghtsoonian, E.	Metallurgy	University of Toronto	900.00
Tjffen, R. J.	Physics	University of Western Ontario	750.00
Versteeg, J.	Chemistry	McGill University	900.00
Walker, J. F.	Chemistry	University of Illinois	1,000.00
Wanless, R. K.	Chemistry	McMaster University	750.00
Webber, H. D.	Chemistry	University of Western Ontario	600.00
Wheeler, R. C.	Chemistry	Queen's University	600.00
Whitaker, Miss J. F. M.	Biology	University of British Columbia	750.00
Whitham, K.	Physics	University of Toronto	750.00
Whittier, A. C.	Physics	McGill University	600.00
Williams, G. J. *	Chemistry	University of Western Ontario	600.00
Wilson, D. G.	Biology	University of Wisconsin	1,000.00
Wilson, E. V.	Chem. Eng.	Queen's University	600.00
Wood, H. A. H.	Geography	McMaster University	750.00
Woodward, H. W.	Geology	Queen's University	750.00
Wormleighton, R.	Mathematics	Princeton University	900.00

Resigned January, 1951.

## APPENDIX III

### ADVISORY COMMITTEES

#### AERIAL SURVEY RESEARCH

##### Main Committee:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Mr. J. A. Brodie	Ontario Dept. of Lands and Forests
Mr. L. J. Chapman	Ontario Research Foundation
Dr. W. Clark	Eastman Kodak Company, Kodak Park Works
Dr. D. R. Derry	Ventures Limited
Mr. W. J. Fulton	Ontario Dept. of Highways
Dr. L. E. Howlett	Physics, National Research Council
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. W. J. Jackson	Williamson Co. of Canada Ltd.
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Corporation
Mr. S. T. B. Losee	Abitibi Power and Paper Co. Ltd.
Prof. O. J. Marshall	Civil Engineering, University of Toronto
Prof. F. F. Morwick	Soils, Ontario Agricultural College
Prof. J. E. Reid	Electrical Engineering, University of Toronto
Mr. A. H. Richardson	Ontario Dept. of Planning and Development
Mr. J. R. G. Smyth	Ontario Dept. of Lands and Forests

Meetings: September 15th and 16th, 1950, Photogrammetric Section,  
Abitibi Power and Paper Co., Sault Ste. Marie.

##### Executive:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Corporation
Mr. A. H. Richardson	Ontario Dept. of Planning and Development

Meetings: April 5th, 1950, 39 Queen's Park, Toronto.



## Photography:

Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Corporation

## Photogrammetry:

Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. K. H. Siddall	Ontario Dept. of Highways
Mr. L. G. Timpson	Ontario Dept. of Lands and Forests
Prof. W. M. Treadgold	Civil Engineering, University of Toronto
Mr. J. G. Wilkinson	Photographic Survey Co. Ltd.

## AGRICULTURAL RESEARCH

### Main Committee:

Mr. C. F. Luckham (Chairman)	Norfolk Specialty Farms
Mr. Ken Betzner	R.R. No. 2, Waterloo
Mr. J. Gordon Blair	Niagara Brand Spray Company Limited
Dr. H. D. Branion	Animal Nutrition, Ontario Agricultural College
Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College
Prof. E. H. Garrard	Bacteriology, Ontario Agricultural College
Dr. E. S. Hopkins	Dominion Dept. of Agriculture
Prof. R. G. Knox	Animal Husbandry, Ontario Agricultural College
Mr. Lawrence Kerr	Chatham
Dr. A. L. MacNabb	Ontario Veterinary College
Mr. M. H. McCurdy	Cockshutt Plow Company Limited
Dr. G. P. McRostie	Field Husbandry, Ontario Agricultural College
Dr. K. W. Neatby	Dominion Dept. of Agriculture
Dr. E. F. Palmer	Ontario Dept. of Agriculture
Mr. A. Pitt	Massey-Harris Company Limited
Mr. F. W. Presant	Toronto Elevators Limited
Prof. G. N. Ruhnke	Research, Ontario Agricultural College
Mr. G. A. Schell	Canada Packers Limited

Mr. J. C. Steckley	Ontario Dept. of Agriculture
Mr. W. G. Toner	Charles Yeates & Co. Limited
Mr. S. B. Trainer	Silverwood Dairies, Limited
Mr. George Wilson	Ontario Dept. of Agriculture
Mr. S. M. Young	International Harvester Company of Canada Limited

Meetings: April 28th, 1950, Ontario Agricultural College, Guelph.

### Co-Ordinating Committee:

Dr. H. D. Branion (Chairman)	Animal Nutrition, Ontario Agricultural College
Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College
Mr. C. F. Luckham	Norfolk Specialty Farms
Dr. E. F. Palmer	Ontario Dept. of Agriculture
Mr. George Wilson	Ontario Dept. of Agriculture
Dr. E. S. Hopkins (Advisory)	Dominion Dept. of Agriculture
Dr. K. W. Neatby (Advisory)	Dominion Dept. of Agriculture

## FISHERIES AND WILDLIFE RESEARCH

### Main Committee:

Dr. J. R. Dymond (Chairman)	Zoology, University of Toronto
Dr. A. M. Fallis (Secretary)	Ontario Research Foundation
Dr. H. Battle	Zoology and Applied Biology, University of Western Ontario
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen
Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. C. D. Fowle	Ontario Dept. of Lands and Forests
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests
Mr. L. Hughes	Northern Ontario Outfitters' Association
Dr. F. P. Ide	Zoology, University of Toronto
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Dr. R. R. Langford	Zoology, University of Toronto

Mr. H. H. MacKay	Ontario Dept. of Lands and Forests
Mr. K. M. Mayall	Ontario Dept. of Planning and Development
Mr. W. Austin Peters	Ontario Federation of Anglers and Hunters
Dr. N. W. Radforth	Botany, McMaster University
Mr. Lester L. Snyder	Royal Ontario Museum of Zoology
Dr. W. M. Sprules <sup>1</sup>	Zoology and Applied Biology, University of Western Ontario
Dr. F. A. Urquhart	Royal Ontario Museum of Zoology
Dr. A. Emerson Warren <sup>2</sup>	Zoology, McMaster University
Mr. Geo. Bishop	Red Lodge, Manitoulin

Meetings: October 21st, 1950, 39 Queen's Park, Toronto.  
February 22nd, 1951, Hotel London, London.

#### Executive:

Dr. J. R. Dymond (Chairman)	Zoology, University of Toronto
Dr. A. M. Fallis (Secretary)	Ontario Research Foundation
Dr. H. Battle	Zoology and Applied Biology, University of Western Ontario
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests

Meetings: February 22nd, 1951, Hotel London, London.

#### Great Lakes Fisheries Research:

Mr. R. N. Johnston (Chairman)	Ontario Dept. of Lands and Forests
Dr. A. O. Blackhurst	Ontario Federation of Commercial Fishermen
Dr. J. R. Dymond	Zoology, University of Toronto
Dr. F. E. J. Fry	Zoology, University of Toronto
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests

Meetings: February 22nd, 1951.

#### Research on Parasites and Diseases in Relation to Fisheries and Wildlife:

Dr. A. M. Fallis (Chairman)	Parasitology, Ontario Research Foundation
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<sup>1</sup> Resigned, January, 1951.

<sup>2</sup> Died, January 7, 1951.

Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests
Dr. C. D. Fowle	Ontario Dept. of Lands and Forests
Dr. A. A. Kingscote	Ontario Veterinary College
Dr. J. F. A. Sprent	Ontario Research Foundation
Dr. F. A. Urquhart	Royal Ontario Museum of Zoology

Meetings: May 1st, 1950, Ontario Veterinary College, Guelph.  
February 22nd, 1951.

### **Wildlife:**

Dr. C. D. Fowle (Chairman)	Ontario Dept. of Lands and Forests
Dr. H. I. Battle	Zoology and Applied Biology, University of Western Ontario
Dr. C. H. D. Clarke	Ontario Dept. of Lands and Forests
Prof. A. F. Coventry	Zoology, University of Toronto
Dr. H. W. Curran	Biology, Queen's University
Dr. A. E. Warren <sup>1</sup>	Zoology, McMaster University

### **Research on Plants in Relation to Wildlife:**

Dr. C. D. Fowle (Chairman)	Ontario Dept. of Lands and Forests
Dr. W. J. K. Harkness	Ontario Dept. of Lands and Forests
Mr. K. M. Mayall	Ontario Dept. of Planning and Development
Dr. N. W. Radforth	Botany, McMaster University
Dr. J. H. Soper	Zoology, University of Toronto

Meetings: October 18th, 1950, Parliament Buildings, Toronto.  
January 23rd, 1950, 39 Queen's Park, Toronto.

### **Publicity:**

Mr. K. M. Mayall (Chairman)	Ontario Dept. of Planning and Development
Dr. N. W. Radforth	Botany, McMaster University
Mr. A. Fenwick	Ontario Dept. of Lands and Forests

Meetings: October 21st, 1950.

March 28th, 1951, 39 Queen's Park, Toronto.

## **FORESTRY RESEARCH**

### **Main Committee:**

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
------------------------------------	---------------------------------

<sup>1</sup> Died, January 7, 1951.



Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Dept. of Planning and Development
Dr. H. W. Beall	Dominion Dept. of Resources and Development
Dr. John E. Bier	Dominion Laboratory of Forest Pathology
Mr. G. G. Cosens	Kimberley-Clark Corporation
Mr. W. A. Delahey	Consulting Forester
Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College
Prof. G. H. Duff	Botany, University of Toronto
Mr. T. L. Dunbar	Consultant, Forest Utilization
Prof. R. O. Earl	Biology, Queen's University
Mr. D. A. Gillies	Gillies Bros. & Co. Ltd.
Mr. J. H. Godden	Great Lakes Paper Company
Dr. O. Holden	The Hydro-Electric Power Commission of Ontario
Prof. R. C. Hosie	Forestry, University of Toronto
Col. J. H. Jenkins	Dominion Dept. of Resources and Development
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Maj. Gen. H. Kennedy	Consulting Engineer
Mr. A. Koroleff	Pulp and Paper Research Institute of Canada
Mr. W. J. LeClair	Canadian Lumbermen's Association
Mr. G. A. Ledingham (Associate Member)	National Research Council Regional Laboratory, Saskatoon
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests
Mr. D. A. Macdonald	Dominion Dept. of Resources and Development
Mr. J. B. Matthews	Abitibi Power and Paper Company Ltd.
Mr. T. A. McElhanney	Grimsby
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Mr. C. R. Mills	Ontario Forest Industries Association
Mr. M. L. Prebble	Forest Insect Laboratory
Mr. K. O. Roos	Booth Lumber Limited
Mr. S. J. Staniforth	Staniforth Lumber Co. Limited
Mr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited
Mr. G. Tunstell	Dominion Dept. of Resources and Development

Meetings: April 14th, 1950, University of Toronto, Toronto,  
September 7th and 8th, Cornwall Street Railway,  
Light & Power Co., Cornwall.

### Executive:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Dr. H. B. Marshall (Secretary)	Ontario Research Foundation
Mr. A. S. L. Barnes	Ontario Dept. of Planning and Development
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. J. B. Matthews	Abitibi Power and Paper Company Ltd.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto

Meetings: March 3rd, 1951, 39 Queen's Park, Toronto.

### Wood Chemistry:

Dr. H. B. Marshall (Chairman)	Ontario Research Foundation
Dr. G. A. Adams	Applied Biology, National Research Council
Dr. F. Bender	Forest Products Laboratory of Canada
Dr. G. A. Ledingham	National Research Council Regional Laboratory Saskatoon
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Dr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited

Meetings: June 19th, 1950, Ontario Research Foundation.

### Forest Biology:

Mr. A. P. Leslie (Chairman)	Ontario Dept. of Lands and Forests
Mr. A. B. Baird	Science Service, Dominion Dept. of Agriculture
Mr. G. G. Cosens	Kimberley-Clark Corporation
Mr. W. A. Delahey	Consulting Forester
Prof. G. H. Duff	Botany, University of Toronto
Prof. R. O. Earl	Biology, Queen's University
Prof. R. C. Hosie	Forestry, University of Toronto
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Maj. Gen. H. Kennedy	Consulting Engineer
Mr. D. A. Macdonald	Dominion Dept. of Resources and Development
Mr. C. R. Mills	Ontario Forest Industries Association
Mr. K. O. Roos	Booth Lumber Limited

Prof. J. W. B. Sisam      Forestry, University of Toronto  
 Mr. W. E. Willson      Abitibi Power and Paper Company Ltd.  
 Meetings: October 23rd, 1950, 39 Queen's Park, Toronto.

### Fire Control:

Mr. J. B. Matthews      Abitibi Power and Paper Company Ltd.  
     (Chairman)  
 Mr. M. H. Baker      Ontario Dept. of Lands and Forests  
 Mr. A. S. L. Barnes      Ontario Dept. of Planning and Development  
 Mr. J. C. Dillon      Ontario Dept. of Lands and Forests  
 Mr. Q. F. Hess      Ontario Dept. of Lands and Forests  
 Mr. R. N. Johnston      Ontario Dept. of Lands and Forests  
 Prof. A. S. Mitchell      Forestry, University of Toronto  
 Mr. James Ruxton      Ontario Dept. of Lands and Forests  
 Prof. J. W. B. Sisam      Forestry, University of Toronto

Meetings: April 3rd, 1950, 39 Queen's Park, Toronto.

### Forestry Research in the Thunder Bay Region:

Prof. J. W. B. Sisam      Forestry, University of Toronto  
     (Chairman)  
 Dr. John E. Bier      Dominion Laboratory of Forest Pathology  
 Mr. W. A. Delahey      Consulting Forester  
 Mr. Gordon Godwin      The Ontario Paper Co. Limited  
 Mr. R. N. Johnston      Ontario Dept. of Lands and Forests  
 Mr. J. B. Matthews      Abitibi Power and Paper Company Ltd.

Meetings: May 29th, 1950, 39 Queen's Park, Toronto.

June 21st, 1950, 39 Queen's Park, Toronto.

### Sawmilling Practice:

Prof. J. W. B. Sisam      Forestry, University of Toronto  
     (Chairman)  
 Dr. H. B. Marshall      Ontario Research Foundation  
     (Secretary)  
 Col. J. H. Jenkins      Dominion Dept. of Resources and Development  
 Mr. W. J. LeClair      Canadian Lumbermen's Association  
 Mr. T. A. McElhanney      Grimsby  
 Mr. K. O. Roos      Booth Lumber Limited  
 Mr. J. F. Sharpe      Ontario Dept. of Lands and Forests

Mr. S. J. Staniforth	Staniforth Lumber Co. Limited
Mr. G. J. Thomson	Peter Thomson & Sons

Meetings: March 5th, 1951, 39 Queen's Park, Toronto.

### Waste Slabwood Utilization:

Prof. J. W. B. Sisam (Chairman)	Forestry, University of Toronto
Mr. James W. Church	Mechanical Engineering, University of Toronto
Col. J. H. Jenkins	Dominion Dept. of Resources and Development
Mr. W. J. LeClair	Canadian Lumbermen's Association
Dr. H. B. Marshall	Ontario Research Foundation
Mr. T. A. McElhanney	Grimsby
Prof. W. G. McIntosh	Mechanical Engineering, University of Toronto
Prof. I. W. Smith	Mechanical Engineering, University of Toronto

Meetings: March 5th, 1951, 39 Queen's Park, Toronto.

## HIGHWAYS RESEARCH

### Main Committee:

Mr. A. K. Hay (Chairman)	Federal District Commission
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways
Mr. T. N. Carter	Carter Construction Co. Ltd.
Mr. L. J. Chapman	Ontario Research Foundation
Mr. W. A. Clarke	Ontario Dept. of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. W. B. Hastings	Ontario Motor League
Mr. R. A. Low	Dominion Dept. of Resources and Development
Mr. W. S. McKay	St. Thomas
Dr. N. W. McLeod	Imperial Oil Limited
Mr. W. J. Moore	Ontario Municipal Board
Mr. F. L. Peckover	National Research Council
Mr. C. A. Robbins	Ontario Dept. of Highways
Mr. D. O. Robinson	Canada Cement Co.
Prof. W. L. Sagar	Civil Engineering, University of Toronto



Mr. J. Walter	Ontario Dept. of Highways
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario
Mr. Harold Cleave (Ex officio)	Bloomfield
Mr. E. Birdsall (Ex officio)	Standard Paving Co. Ltd.

Meetings: April 21st, 1950, Board Room, Dept. of Highways, Toronto.  
October 13th, 1950, Salon "A", Chateau Laurier, Ottawa.

#### Executive:

Mr. A. K. Hay (Chairman)	Federal District Commission
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. N. W. McLeod	Imperial Oil Limited
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Mr. J. Walter	Ontario Dept. of Highways

Meetings: June 16th, 1950, 39 Queen's Park, Toronto.

#### Traffic and Planning:

Mr. W. J. Fulton (Chairman)	Ontario Dept. of Highways
Mr. A. E. K. Bunnell	Ontario Dept. of Planning and Development
Mr. W. A. Clarke	Ontario Dept. of Highways
Mr. R. A. Low	Dominion Dept. of Resources and Development
Mr. J. M. MacInnes	Ontario Dept. of Highways
Mr. G. R. Marston	County Engineer, Simcoe
Mr. J. L. Zoller	Ontario Dept. of Highways

#### Design:

Mr. D. J. Emrey (Chairman)	County Engineer, Kitchener
Mr. T. F. Francis	Ontario Dept. of Highways
Mr. R. M. Lee	County Engineer, Brantford
Mr. N. W. McLeod	Imperial Oil Limited
Mr. D. G. Ramsay	Ontario Dept. of Highways

Mr. D. O. Robinson	Canada Cement Co.
Mr. J. Walter	Ontario Dept. of Highways

### Soils and Foundations:

Mr. J. Walter (Chairman)	Ontario Dept. of Highways
Mr. D. J. Emrey	County Engineer, Kitchener
Mr. R. A. Low	Dominion Dept. of Resources and Development
Mr. A. D. McGinnis	McGinnis and O'Connor
Dr. N. W. McLeod	Imperial Oil Limited
Mr. D. G. Watt	The Hydro-Electric Power Commission of Ontario

### Materials and Construction:

Mr. T. F. Francis (Chairman)	Ontario Dept. of Highways
Mr. C. Fraser	Ontario Dept. of Highways
Mr. T. Johnston	Ontario Dept. of Highways
Mr. E. W. Jones	County Engineer, Barrie
Mr. T. R. Patterson	County Engineer, Goderich
Prof. W. L. Sagar	Civil Engineering, University of Toronto

## INDUSTRIAL RESEARCH

### Main Committee:

Mr. C. A. Pollock (Chairman)	Dominion Electrohome Industries, Ltd.
Mr. Lorne C. Anderson	Ontario Paper Co. Limited
Mr. H. L. Bemis	Campbell Soup Company Ltd.
Mr. G. C. Bernard	Canadian Manufacturers' Association Inc.
Mr. T. W. Brackinreid	Phillips Electrical Works
Mr. Lorne S. Campbell	Ontario Dept. of Planning and Development
Mr. Howard Chamberlain	Lowe Brothers Co. Ltd.
Mr. T. A. Faust	Yocum Faust, Limited
Mr. R. W. Keeley	Bendix-Eclipse of Canada Limited
Col. F. J. Lyle	Ontario Dept. of Planning and Development
Col. D. F. MacRae	Ontario Research Foundation
Mr. D. Alan Page	Mercury Mills Limited
Mr. W. J. W. Reid <sup>1</sup>	Otis Elevator Company Limited
Dr. H. B. Speakman	Ontario Research Foundation

<sup>1</sup> Resigned, January 30, 1951.

Mr. D. W. Stewart, Jr.	Renfrew
Mr. D. B. Strudley	Imperial Rattan Co., Limited
Mr. J. N. Swinden	Great Lakes Lumber and Shipping, Ltd.
Mr. A. B. Ward	Ontario Research Foundation

Meetings: April 21st, 1950, Royal York Hotel, Toronto.  
 June 20th, 1950, Royal York Hotel, Toronto.  
 September 12th, 1950, Royal York Hotel, Toronto.  
 November 7th, 1950, Hawthorne Farm, Milton.  
 December 6th, 1950, Royal York Hotel, Toronto.  
 February 7th, 1951, Hart House, Toronto.

## INDUSTRIAL WASTE

### Main Committee:

Prof. A. C. Plewes (Chairman)	Chemical Engineering, Queen's University
Mr. A. E. Berry	Ontario Dept. of Health
Mr. G. A. H. Burn	Ontario Dept. of Health
Mr. A. V. DeLaporte	Ontario Dept. of Health
Prof. J. D. Lee	Civil Engineering, Queen's University
Mr. H. S. Matthews	Matthews-Wells Company Limited
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto
Mr. Alex D. McRae	Imperial Oil Limited
Mr. W. C. Miller	City Engineer, St. Thomas
Mr. A. E. Proctor	Brantford Produce Co. Limited
Mr. H. B. Speakman	Ontario Research Foundation

Meetings: April 29th, 1950, 39 Queen's Park, Toronto.  
 November 3rd, 1950, 39 Queen's Park, Toronto.  
 February 2nd, 1951, 39 Queen's Park, Toronto.

## MINES, MINERALS AND METALLURGY

### Main Committee:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Prof. H. S. Armstrong	Geology, McMaster University
Prof. O. A. Carson	Metallurgy, Queen's University
Mr. O. W. Ellis	Ontario Research Foundation

Dr. C. S. Evans	Union Gas Company of Canada, Ltd.
Dr. G. S. Farnham	The International Nickel Co. of Canada, Ltd.
Dr. D. L. H. Forbes	The Teck-Hughes Gold Mines, Ltd.
Mr. T. W. Hardy	Climax Molybdenum Company
Prof. J. E. Hawley	Mineralogy, Queen's University
Mr. G. S. Hume	Dominion Dept. of Mines and Technical Surveys
Prof. G. B. Langford	Geological Sciences, University of Toronto
Prof. L. M. Pidgeon	Metallurgical Engineering, University of Toronto
Prof. G. H. Reavely	Geology, University of Western Ontario
Mr. H. C. Rickaby	Ontario Dept. of Mines
Mr. R. H. Rimmer	Aluminium Laboratories Ltd.
Mr. W. Samuel	Steep Rock Iron Mines Ltd.
Dr. C. R. Whittemore	Deloro Smelting & Refining Co. Ltd.
Dr. G. E. Willey	Algoma Steel Corporation, Ltd.
Prof. C. G. Williams	Toronto
Prof. J. T. Wilson	Physics, University of Toronto
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario

Meetings: October, 27th, 1950, Mining Building,  
University of Toronto, Toronto.

#### Executive:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association
Dr. O. W. Ellis	Ontario Research Foundation
Mr. H. C. Rickaby	Ontario Dept. of Mines
Prof. C. G. Williams	Toronto
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario

Meetings: May 11th, 1950, 39 Queen's Park, Toronto.

#### Wire Rope:

Dr. O. W. Ellis (Chairman)	Ontario Research Foundation
Mr. I. A. Usher (Secretary)	Ontario Research Foundation



Mr. N. B. Brown	Dominion Dept. of Mines and Technical Surveys
Mr. W. E. Brown	B. Greening Wire Co. Ltd.
Mr. R. E. Dye	Dome Mines Ltd.
Mr. A. C. Halferdahl	National Research Council
Mr. R. L. Healy	Wright-Hargreaves Mines Ltd.
Mr. J. G. Morrow	Steel Company of Canada Ltd.
Mr. R. D. Parker	International Nickel Co. of Canada, Ltd.
Mr. N. F. Parkinson	Ontario Mining Association
Mr. R. S. Segsworth	General Engineering Co. (Canada) Ltd.
Mr. D. G. Sinclair	Ontario Dept. of Mines
Mr. L. W. Sproule	Imperial Oil Ltd.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario

Meetings: April 11th, 1950, Ontario Research Foundation, Toronto.

#### **Ferrous Metallurgy:**

Dr. O. W. Ellis (Chairman)	Ontario Research Foundation
Mr. P. E. Cavanagh (Secretary)	Ontario Research Foundation
Mr. T. W. Hardy	Climax Molybdenum Company
Mr. F. A. Loosley	Dominion Foundries and Steel Ltd.
Mr. W. Samuel	Steep Rock Iron Mines Ltd.
Mr. R. J. Traill	Dominion Dept. of Mines and Technical Surveys
Mr. D. G. Watt	The Hydro-Electric Power Commission of Ontario
Mr. G. E. Willey	Algoma Steel Corporation, Ltd.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario
Mr. T. H. Adair (Co-operating)	Atlas Steel Company
Prof. G. Letendre (Co-operating)	Laval University
Mr. J. S. McMahan (Co-operating)	Steel Company of Canada Ltd.
Mr. Norman Parlee (Co-operating)	Dominion Steel and Coal Co.

Mr. N. F. Parkinson      Ontario Mining Association  
(Ex officio)

Meetings August 4th, 1950, Ontario Research Foundation, Toronto.  
September 18th, 1950, Ontario Research Foundation, Toronto.  
December 15th, 1951, Ontario Research Foundation, Toronto.  
January 12th, 1951, Ontario Research Foundation, Toronto.  
March 2nd, 1951, Ontario Research Foundation, Toronto.

### Geology:

Prof. G. B. Langford      Geological Sciences, University of Toronto  
(Chairman)  
Mr. J. O. Gorman      The Hydro-Electric Power Commission of  
Ontario  
Prof. J. E. Hawley      Mineralogy, Queen's University  
Dr. D. F. Hewitt      Ontario Dept. of Mines  
Mr. M. E. Hurst      Ontario Dept. of Mines  
Dr. H. S. Scott      Physics, McMaster University

### Non-Ferrous Metallurgy:

Dr. C. R. Whittemore      Deloro Smelting & Refining Co. Ltd.  
(Chairman)  
Dr. O. W. Ellis      Ontario Research Foundation  
Dr. G. S. Farnham      International Nickel Co. of Canada, Ltd.  
Mr. W. M. Goodwin      Dominion Dept. of Mines and Technical  
Surveys  
Mr. L. J. Lichty      Ventures, Ltd.  
Dr. L. M. Pidgeon      Metallurgical Engineering, University of  
Toronto  
Mr. M. J. Tamplin      Falconbridge Nickel Mines

### SOILS

#### Main Committee:

Mr. L. J. Chapman      Ontario Research Foundation  
(Secretary)  
Prof. E. H. Garrard      Bacteriology, Ontario Agricultural College  
Mr. G. Angus Hills      Thornhill  
Mr. R. N. Johnston      Ontario Dept. of Lands and Forests  
Dr. A. Leahey      Dominion Dept. of Agriculture  
Prof. F. F. Morwick      Chemistry, Ontario Agricultural College  
Dr. E. F. Palmer      Ontario Dept. of Agriculture

Mr. F. L. Peckover	National Research Council
Prof. D. F. Putnam	Geography, University of Toronto
Mr. A. H. Richardson	Ontario Dept. of Planning and Development
Prof. G. N. Ruhnke	Research, Ontario Agricultural College
Prof. W. L. Sagar	Civil Engineering, University of Toronto
Prof. J. W. B. Sisam	Forestry, University of Toronto
Mr. H. B. Speakman	Ontario Research Foundation
Mr. J. Walter	Ontario Dept. of Highways

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## APPENDIX IV

### ADMINISTRATIVE STAFF

Mr. O. Wilhelm	Director
Miss W. Peters	Secretarial-Stenographer
Miss R. S. Ash	Clerk, Group III
Miss J. A. McGillicuddy	Clerk, Group II





**RESEARCH COUNCIL OF ONTARIO**

**Annual Report - 1952**



# RESEARCH COUNCIL OF ONTARIO

## *Fourth Annual Report*

1951 - 1952



ONTARIO

TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY

Research Council of Ontario  
39 Queen's Park Crescent,  
Toronto 5, Ontario.

October 28, 1952.

The Honourable William Griesinger,  
Minister of Planning and Development.

Sir:

Attached hereto is the Director's report of the Research Council of Ontario for the fiscal year April 1, 1951, to March 31, 1952. As in previous years, this report is a concise review of the activities of the Council and Advisory Committees.

The Director continues to inspire the Advisory Committees in their respective fields to such an extent that the results of this work are of increasing value to the Council in assessing the research activities throughout the province. One of the significant phases of the work of these committees is that they are able to bring together for consultation and study scientists from federal and provincial departments, university professors and industrialists. Furthermore, it is only necessary to attend a few of the Advisory Committee meetings to realize what an excellent role they are playing in encouraging the exchange of information and developing enthusiasm among research people in different organizations. While the committees have no authority, it is obvious that they assist materially in formulating the programmes of the various research groups in the province.

It is the hope of the Council that within a year it will be in a position to present to the government a concrete survey of the adequacy of research conducted in the province, and also make recommendations with regard to future direction and expansion.

Respectfully submitted,

R. K. STRATFORD,

President



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## RESEARCH COUNCIL OF ONTARIO

DR. R. K. STRATFORD <sup>1</sup>	- - -	Scientific Adviser, Imperial Oil Limited, Sarnia.
(President)		
DR. G. E. HALL <sup>2</sup>	- - -	President, University of Western Ontario, London.
(Vice-President)		
DR. G. P. GILMOUR	- - -	President, McMaster University, Hamilton.
DR. E. HOLT GURNEY	- - -	Chairman of the Board, Gurney Products Limited, Toronto.
MR. HUGH LAWSON	- - -	Vice-President, York Knitting Mills Limited, Toronto.
DR. W. A. MACKINTOSH <sup>3</sup>	- - -	Principal, Queen's University, Kingston.
COL. W. E. PHILLIPS	- - -	50 St. Clair Ave. W., Toronto.
PROF. G. N. RUHNKE	- - -	Director of Research, Ontario Dept. of Agriculture, Guelph.
DR. SIDNEY E. SMITH	- - -	President, University of Toronto, Toronto.
DEAN K. F. TUPPER	- - -	Faculty of Applied Science & Engineering, University of Toronto, Toronto.
MR. H. M. TURNER	- - -	President, Canadian General Electric Co. Ltd., Toronto.
DR. R. C. WALLACE <sup>4</sup>	- - -	Principal, Queen's University, Kingston.

### Director:

J. O. WILHELM	- - -	Research Council of Ontario, Toronto.
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### Meetings:

June 15th, 1951, Queen's Biological Station, Chaffey's Locks.

November 17th and 18th, 1951, General Brock Hotel, Niagara Falls.

March 7th and 8th, 1952, Guild Inn, Scarborough.

1 Appointed President September 1st, 1951.

2 Elected Vice-President November 17th, 1951.

3 Appointed October 25th, 1951.

4 Resigned August 31st, 1951.

### Executive:

DR. R. K. STRATFORD (President)	DR. G. E. HALL (Vice-President)
DR. E. HOLT GURNEY	MR. HUGH LAWSON DEAN K. F. TUPPER

### Meetings:

April 11th, 1951, Royal York Hotel, Toronto.

September 27th, 1951, 39 Queen's Park, Toronto.

November 7th, 1951, 39 Queen's Park, Toronto.

November 17th, 1951, General Brock Hotel, Niagara Falls.

January 10th, 1952, 39 Queen's Park, Toronto.

March 6th, 1952, Guild Inn, Scarborough.

### Scholarship Committee:

DR. R. K. STRATFORD (ex officio)	PROF. G. N. RUHNKE
DR. G. E. HALL	DR. SIDNEY E. SMITH
DR. G. P. GILMOUR	DEAN K. F. TUPPER
MR. HUGH LAWSON	DR. H. B. SPEAKMAN (advisory)
DR. W. A. MACKINTOSH	J. O. WILHELM (ex officio)

### Meetings:

March 6th and 7th, 1952, Guild Inn, Scarborough.

## DIRECTOR'S REPORT

The Research Council held three regular meetings and the executive met six times. The President with the Director met with ministers and departmental officials of both the provincial and federal governments. The Director attended most of the meetings of the Advisory Committees.

### Scholarships

The Scholarship Committee met on March 6th and 7th, 1951, to consider the applications and make the awards for the 1952-53 session. Interviews with students and professors were arranged to present the opportunities for scholarships, to facilitate the submission of applications, and to assist the students in making contact with research opportunities. During January the Director visited the Ontario universities to interview students and to discuss the students and their research programs with the professors. A second visit was made to each university by Miss Ash a few days later to assist the students in the preparation of their applications.

The Scholarship Committee has recognized the necessity of encouraging research biologists in their post-graduate studies. The 46 scholarships awarded for the 1952-53 session were distributed among the sciences as follows: physics, 16; biology, 12; mathematics, 9; chemistry, 7; engineering, 5; and geology, 1. Since the beginning of the scholarship plan in 1946, a total of 373 scholarships have been awarded. The distribution among the sciences was physics, 128; biology, 102; chemistry, 57; engineering, geology and metallurgy, 37; mathematics, 30; and others, 19.

### Ontario Research Foundation

The closest possible contact was maintained with the Ontario Research Foundation. Dr. Speakman, Mr. Stadelman and the staff of the Foundation co-operated fully in all phases of the work and were available at all times for consultation on joint problems. The Council continues to occupy one floor of the house at 39 Queen's Park Cresc. East. The Foundation use the remainder of the building and have looked after the servicing of the building.

The programs of work in the Foundation which have been supported by the Council are related to the major industries processing raw products. There are two exceptions, the program on physiography and climatology and the program on parasitology. These are programs of basic research having application mainly to fundamental developments in forestry and agriculture. During the current year approximately one-half of the Research Council's budget for grants-in-aid was spent on projects in the Foundation (\$246,500).

Several group research projects were continued by the Foundation and new ones are under discussion.

## Universities

During the year \$157,030 was expended in the support of program of research within the universities. These grants are made to individual professors for work that has been considered by one or other of the Advisory Committees. It forms an integral part of the university research structure. The direction of the program is the responsibility of the professor. The Research Council through its committees endeavours to bring together all the indirect support that may help a particular research program to go forward. The dollar value of university research programs is not easy to assess due to their fundamental nature. All programs are reviewed by the Advisory Committees, which assures the value of the work and justifies the financial support of the Government.

## Forestry

The research being directed in forestry is covered by the report of Dean Sisam, Chairman of the Forestry Committee. Special mention should be made of the completion of the regeneration survey that has been going forward during the last few years. This report will serve as a basis for the planning of development and research programs within the Province and will provide basic information for those who are building up management plans.

The development of research in the field of wood chemistry is going forward in the Foundation and the universities. The Forestry Committee some years ago brought to the attention of the chemists in the Provincial universities the need for work in the field of wood chemistry. Projects which are now being supported are a part of what it is hoped will develop into an adequate research program.

The Forestry Committee have been trying to stimulate an interest on the part of industry and various research groups in new methods for the treatment of wood waste from both primary and secondary operations. The Committee in co-operation with the Forest Products Laboratory of the Department of Resources and Development in Ottawa have been attempting to clarify some of the techniques of the manufacture and operation of saws and sawmill equipment. The Research Council of Ontario is supporting the mechanical engineering phases of this development which are being carried out in the Mechanical Engineering Department of the University of Toronto. The Forest Products Laboratory of the Federal Department of Resources and Development have set up a research sawmill of standard design on which modifications may be made and measured. This mill fully instrumented to give complete data on all the factors involved.

## Fisheries and Wildlife

The fisheries research program so far as the smaller lakes and the streams of the Province are concerned is well rounded out. Discussion



have been going forward during the year to develop an adequate program of research for the Great Lakes. The organization of effort and financial support is complicated because of the fact that the Great Lakes as international waters bring together Canada, six States and the Federal Government of the United States. Progress is being made but a body of water as large as any one of the Great Lakes presents a variety of problems that will take many years of study.

In the field of terrestrial biology the Committee have been trying to develop an overall program in the Province. During the past year new projects were started at several points. Within a few years results will accumulate which should clarify the problems that arise in the management of wild life in the forests and in the agricultural areas. One phase of this work which is important in wild life management and animal husbandry and has some relation to human welfare as well, is the field of parasitology. The work, supported by the Council, has been centred in the Foundation with close liaison being maintained with the Royal Ontario Museum and the Ontario Veterinary College.

### **Industrial Research**

The main interest in Industrial Research has been directed toward the assistance of small industries. The Industrial Research Services of the Ontario Research Foundation which was begun in 1947 has developed substantially and the Committee are now considering what extensions of this service should be made and what might be done to complement this work.

With the view to developing a wider appreciation of the value of research on the part of industry and of making use of the judgment of industrial executives, the group research idea has been discussed. During the year members of the Committee and others have expended a good deal of effort in bringing to the attention of industry the group research plan of co-operation between industry and the government.

### **Industrial Waste**

The programs coming directly under this Committee have continued. Interim reports and papers have been presented in the field of milk, cannery and chemical wastes. The Committee have worked to obtain greater application of much of the knowledge that is available.

The testing and research facilities in the Sanitary Engineering Division of the Department of Health should be expanded. The laboratory, too, is the natural centre for educational programs (both pre-employment and post-employment) for industrial and municipal sanitary engineers.

The Committee has maintained a close liaison between the Department of Health and the Conservation Division of the Department of Planning

and Development and the Research and Management Divisions of the Department of Lands and Forests, with respect to the standardization and correlation of water testing.

## Highways

During the year the only research work directly associated with highway within the Province has been that carried out in the Soils Division of the Department of Highways. This work has been related specifically to the program of highway construction in the Department of Highways. Within this field the work is in the forefront of Highways research on this continent and in the United Kingdom.

The Committee keep in touch with experimental work being conducted in the United States and Britain. Members of the Committee have attended meetings in the United States and presented papers to meetings in various parts of Canada.

The Committee have from the beginning recommended that the facilities for the dissemination of research information should be improved. The Department of Highways has under consideration a building program which will provide more adequate quarters for the research section. The library facilities included there may well be the provincial centre for the collection and distribution of research information.

## Mines, Minerals and Metallurgy

The main programs under this Committee during the year were the wire rope and metallurgical programs in the Ontario Research Foundation. A group research project with the Ontario Mining Association on a non-destructive device for the testing of mine cables in service has gone forward and is undergoing preliminary field tests.

The Committee continued to assist various university departments in more fundamental research using geophysical, spectrographical and geochemical methods to attack specific problems in the prospecting for and processing of Canadian minerals.

## Agriculture

This Committee was reorganized during the latter part of 1951 to represent more adequately the agencies doing research in agriculture, the institutions responsible for communicating the results of agricultural research to those who use them, and the farmers and growers who look to the research specialists for solutions to their problems.

The personnel of the reorganized committee is given in Appendix II.

## Soils

Pending the reorganization of the Advisory Committee on Agriculture, the Advisory Committee on Soils was not called together.

## Spanish River Pollution Committee

During the year the Council Committee on the Spanish River Pollution studies submitted their final report to the Minister of Lands & Forests.

The administrative work has been made easy by the diligence and efficiency of the office staff. Due to the development of the work it will be necessary during the coming year to add to the staff. The members of the Council, members of the Government departments, university professors, and industrial executives have all been very co-operative.

## ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Prof. J. W. B. Sisam

The value of our basic forest products in Ontario is second only to that of agriculture. To provide a continuous yield of the most valuable tree species is a problem of first importance, as it is to-day in all countries possessing great forest assets. Moreover, in many areas of Southern Ontario a program of reforestation is especially necessary as a land conservation measure. These areas, once cleared, have now reverted to abandoned farmland with an increasing waste caused by flooding and soil erosion.

During 1951 the Advisory Committee on Forestry Research has been most concerned with these two problems. The Committee met in May at Kapuskasing to discuss, in addition to its other research projects, the special problem of reproducing black spruce in areas now being cut, and also to visit the Spruce Falls Pulp & Paper mill and limits in order to observe something of the conditions affecting forest operations in Northern Ontario. Reports were presented on the progress of research projects supported by the Research Council of Ontario, notably the planting of forest trees after cut-over, the germination of red pine seed, the investigation of essential oil derived from wood, the die-back in yellow birch as it may affect trees in Ontario, the influence of soil fungi on nutrition of seedlings, and soil and climatic classifications. To each of the subjects under discussion were contributed the opinions of scientists from Dominion and Provincial departments who are represented on the Advisory Committee, as well as from the representatives from industry. The progress of similar or supporting research being conducted outside Ontario was drawn to the attention of the Advisory Committee.

In October a meeting was held at Maple to study the results of research in tree breeding being conducted at the Southern Experimental Station of the Department of Lands & Forests, and a business session followed at the Faculty of Forestry, University of Toronto. The purpose of this meeting was to present to the Advisory Committee information on forest tree breeding, particularly in its relation to forest management in Ontario, and to review related research being conducted elsewhere in Canada and abroad. The progress of such research in several localities in the United States was presented by Professor A. J. Riker of the University of Wisconsin. The tree-breeding program in spruces carried on by the Dominion Forest Service with the object of developing superior strains was also outlined, as well as the program of forest genetics being conducted by Dr. Heimburger at Maple, Ontario, with the support of the Research Council of Ontario. Other projects assisted by the Research Council were reviewed, notably Professor Earl's investigation of "sick soil" and methods of treating it, natural growth of forests in Ontario, research in sawmilling, uses of wood waste and wood chemistry.





(Courtesy Faculty of Forestry, University of Toronto)

Experiment in assisting natural re-growth of jackpine. Cone-bearing branches are placed on the ground after logging. Results on the cleared strip are compared with results in the brush alongside. Similar experiments have been done with spruce.

## Regeneration

Many independent surveys have been made in past years to gauge the success of natural re-growth of trees after logging operations. Regeneration of forests is a complex phenomenon, varying widely in quantity and character with such conditions as soil, elevation, drainage, exposure, light. A study of the reports of many surveys made independently over the past thirty years has been completed since 1947 by Professor Hosie of the University of Toronto. Professor Hosie's findings re-affirm the need for an extended study of natural regeneration and for a program of tree planting on cut-over and burned-over areas. His report, soon to be published, will be given wide circulation among those who are interested either technically or administratively in the proper management of the forest resources of this Province.

Most of the information on which the report is based pertains to the pulpwood forests, particularly those represented by spruce and balsam fir, our most valuable pulpwood species. Natural regeneration on the cut-over areas is far from successful. It varies from poor to satisfactory, and the situation in general is less favourable for spruce. In order to place the future forest economy of the Province on a sound basis, well-stocked stands of desirable species will need to be established on the cropped sites. In some cases the forests may have to be re-established by planting.

Planting is an expensive undertaking, and it is therefore basic to use high-grade planting stock, to establish it on sites of high quality, and to develop planting methods suited to bush conditions. These are matters in which we are by no means fully informed as yet, and on which research is going forward, though not to the extent fully required. The quality of the planting stock, in so far as it is affected by inherited characteristics, is a problem of forest genetics.

## Forest Genetics

Forest trees that have been investigated genetically have been found to be a complex of characters of widely varying value, some desirable, others the reverse, and many of these characters are, of course, likely to be passed on to subsequent generations. In establishing new stands by means of plantations, it is possible to have full control over the source of seed to be used. The control of seed source has reached the stage in some Scandinavian countries where selected trees of high quality are grown in orchards for the production of seed to be used in future planting operations. The results must be in marked contrast to those of present-day logging methods, which usually aim at removing all mature trees of commercially valuable species and particularly all the dominant trees of the best form and vigour. Unless advance growth is present or planting is undertaken the next crop will be produced from seed provided by the trees left on the area, which are usually of relatively poor quality and slow growth.

By selective breeding and crossing between different natural strains, it may be possible to develop new strains in which the desirable features are increased. During the past few years the Ontario Department of Lands and Forests has developed a research program in forest genetics under Dr. Heimburger at the Southern Experiment Station at Maple. The main problems that Dr. Heimburger is investigating at the present time are (a) the development of a white pine strain or hybrid that will produce high-grade lumber and is resistant to the blister rust disease, and (b) the development of a fast-growing poplar, well adapted to climatic conditions in Southern Ontario that can be grown on a short rotation to provide raw material for the pulp and paper industry. The Research Council of Ontario is participating in the financial support of this program.

### Forest Tree Relationship with Fungous Growth

The nutritional effect on trees of fungi in forest soil is still very much a matter of question. Some trees appear to derive mineral plant food by close association of their fine network of rootlets with certain species of fungi. During the past two years a program of research in this field has been developed by Dr. G. H. Duff of the Department of Botany, University of Toronto, with the financial assistance of the Research Council of Ontario. During the past year the work has been expanded and Dr. Visvaldis Slankis, formerly of Melins Laboratory at Uppsala, Sweden, has been working as an associate. Dr. Slankis has a most valuable background of research experience in this field.

### Diseases of Forest Trees

Losses due to fire account for 8% of the yearly drain on our forests, while losses due to insects and diseases, though less spectacular, account for 5%.

The co-operative study developed in 1949 between Dominion and provincial foresters in the problems of birch die-back is continuing, and also is research in decay of white pine. Both these projects are given assistance by the Research Council of Ontario.

Many of our sugar maple trees in Southern Ontario are defective, owing to the attack of various organisms that cause wood decay. During the past two years fundamental studies of these diseases have been made by Dr. J. M. Good of the Department of Biology, Queen's University. This fundamental research project is also given support by the Research Council of Ontario. The work may well provide information of importance in the management of our hardwood forests for the production of high-grade lumber and veneer.



## Group Research

In our report of 1949-50, it was pointed out that proposals had been made and discussed by the Committee for developing forestry research in this Province on a regional basis, and that under such a scheme opportunities would be provided for forest industries within a particular region to co-operate among themselves and with the Provincial Government in the study of problems of common interest under a group research plan. This proposal was brought to the attention of a number of the pulp and paper companies operating in the Thunder Bay region of the Province. Two of the companies — the Ontario Paper Company Limited and the Abitibi Power and Paper Company Limited — have shown interest in the plan since it was first suggested, and have discussed it with officials of the Pulp and Paper Research Institute of Canada at Montreal. These two companies have now agreed upon a single project that might be undertaken in the region in question and which is of common interest in the management of their respective limits.

## Waste in Utilization of Wood

The problem of waste which accompanies our forest operating and wood-using industries has been of great concern to the Committee during the past two years. This includes waste of raw wood in the forest and mill as well as the discarding of large quantities of by-products from wood-processing industries. The loss is a growing problem to both industry and the Government. For example, in the manufacture of sulphite pulp, about 50% of the wood is discarded in the form of waste sulphite liquor, representing a loss of some 15 million lbs. per day from Canadian pulp mills. The conversion of saw-logs to lumber at present results in a final product representing only about 50% of the original volume of wood. The remaining 50% is only occasionally used efficiently in the manufacture of some saleable by-product. These two aspects of wood waste have been the subject of research conducted by two of our Forestry sub-committees, those dealing with sawmilling and with wood chemistry.

## Sawmilling

In addition to the failure in most sawmills to use slabwood, trimmings etc. to the best economic advantage, there is a basic waste resulting from antiquated types of equipment and practices. Millions of board feet of potential lumber are reduced to sawdust annually in Canada because of the width of the incision made by circular saws now in use. The last major development in sawmilling equipment in Canada was the introduction of the bandsaw in the 1890's.

Since 1947 progress made by the Sub-Committee on Sawmilling has had the following results:

(1) A report was completed in 1948 of a survey made on sawmill machinery by Professor W. G. McIntosh of the Department of Mechanical



Engineering, University of Toronto. The purpose of the survey was to learn of any existing developments in this or other countries which could be applied to needs in Canada. Much interest was provided by small and portable sawmills and auxiliary equipment such as edgers, trimmers, and cut-off saws.

(2) A research sawmill has been established at the Forest Products Laboratory in Ottawa. Research in the mechanical engineering phases of this work is supported by Research Council of Ontario grants to the Department of Mechanical Engineering at the University of Toronto. The testing equipment has been calibrated. Gauges for the measurement of forces on the head saw had to be designed. Preliminary test runs with a number of tree species have been made.

(3) Investigations at the Department of Mechanical Engineering, University of Toronto, into basic engineering problems affecting sawmill machinery and operation were organized in 1950 with the assistance of the Research Council. This basic research is continuing, but the point is now reached where the Advisory Committee on Forestry recommends that some results be tested in practical sawmilling tests, in co-operation with the Department of Lands and Forests.

## Reports and Publications

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- "Utilization of Coniferous Brush for Essential Oil Production." A. C. Shaw. Presented January 22nd, 1951 to the Ontario Forest Industries Association Convention.
- "The Utilization of Waste Sulphite Liquor." A Bibliography of the Literature published during 1951, compiled by H. Borden Marshall. (Reprinted from Pulp & Paper Magazine of Canada, April, 1952).
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(Courtesy Department of Lands & Forests, Ontario)

... of Lakes Ontario, Algonquin Park

The sampler traps the minute quantities of animal

## ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE

Chairman: Prof. J. R. Dymond

A rough estimate has shown that approximately 90% of the land and water area of Ontario will produce fish and wildlife, and that more than half of this large portion will produce no other permanent crop. The economic and recreational value of a great part of the Province depends, therefore, on the maintenance of our valuable species of fish, birds and animals. The problem of fish and wildlife management, however, is magnified by the breadth of the area, the variety of species involved, and the difficulties of studying them in their native habitats.

Long continued observations on wildlife are necessary because of the many factors affecting the survival and growth of animals in nature and the great variability of such conditions as temperature, moisture, light, cover, food, natural enemies, competitors, parasites and disease. The presence of game and fur-bearing animals is related closely to forest conditions, and changes in these conditions must be traced over a long period. It is not usually enough to conduct separate studies of forestry, zoology, insect life, etc. at different places and times, because even pooled results will not reveal the same interrelationships as can be obtained from simultaneous studies in the same area.

Similarly the understanding of certain changes in fish populations, affected by food supply, competitors, and enemies, usually requires upwards of 10 years of observation. Nature is continually varying the factors upon which the biologist must base his measurements. The biologist must therefore repeat his recordings under as many sets of conditions as is necessary to establish conclusions. Such research takes time, as well as trained personnel and proper equipment.

Since the Government is almost wholly responsible for the management of fish and wildlife in the Province, research in these fields is largely supported by industry. It is carried on by the universities, the Research Division of the Department of Lands and Forests, the Ontario Research Foundation, and the Royal Ontario Museum. However, the Advisory Committee on Fisheries and Wildlife of the Research Council of Ontario, whose objective is to encourage and integrate the research, has among its twenty-four members five representatives from commercial organizations (Ontario Federation of Commercial Fishermen, Ontario Federation of Anglers and Hunters, and Northern Ontario Outfitters' Association).

The cost of research in fisheries and wildlife has greatly increased. To find what causes one body of water to produce more than another requires chemical analyses of all the numerous nutrients in the water and measurements of the penetration of light as well as the populations of the fish produced. This information is also necessary in developing means to enrich waters through fertilization. In wildlife research it was at one time possible to get data on a sufficient number of animals by trapping a few acres



using traps costing a few cents each. To-day information on the populations of moose or deer or even beavers and muskrats requires that a great deal of territory be covered using much more expensive equipment including even aircraft.

Research in fisheries and wildlife in Ontario divides into two fairly distinct categories. The first, which aims at the discovery of basic or fundamental knowledge, is carried on at the universities, the Ontario Research Foundation, and the Museum. In addition to the pure research which they conduct in biology the universities also render a vital service in training biologists capable of administrative or field work. Lack of funds and equipment in the universities greatly limits the training of graduate students who are necessary for an adequate program of academic research. The support given to four universities through the Research Council of Ontario has made possible the initiation of many research projects in biology which are basic to fisheries and wildlife management. Similar support has also been given to graduate students who are engaged in biological work in Provincial organizations and the Research Foundation.

Problems of bird and animal diseases that have been under investigation at these institutions are:

- Liver fluke disease in deer
- Trichinosis in Arctic animals
- Collection of parasites from Ontario animals
- Disease in beavers
- Blackflies as disease-carriers
- Ascaris infection in animals
- Blood parasites in ducks and grouse
- Swimmers' itch

Among other projects under consideration are:

- Causes of disease in muskrats
- Effect of ticks on the health and mortality of moose
- Effect of hydatid disease on the health of moose and the relation of this disease to man
- Parasite epidemics among rabbits and hares
- Effect of disease epidemics on populations of grouse and pheasants
- Importance of starlings as disease and parasite carriers
- Occurrence of kidney worm in mink
- Occurrence of gapeworm in pheasants
- Occurrence of guinea worm in mink and raccoon
- Occurrence of pullorum disease in wild birds

A catalogue of parasites affecting many of our mammals, birds, and fishes has been established at the Research Foundation, and it is desirable that a further catalogue be begun to classify diseases found in wild animals.



A few of the special activities of the Committee are dealt with in greater detail in the following sections:

## Study of Parasites

The study of parasites needs more immediate support. Diseases caused directly or indirectly by parasites are at times responsible for the death of large number of game and fur-bearing animals. We know so little about the causes of death of animals in nature that we have no clear picture of just how important disease is in determining the populations of wild creatures, but the more our knowledge grows the more important this factor appears to be. Animal life, taken generally, is found in three major places: in the water, on land, and in or on other animals. It may be that the study of parasites considered broadly will constitute one-third of all zoology.

Some diseases of wild animals are related to diseases in domestic animals and humans. Rabies in foxes can be transferred to dogs and man. Domestic swine may harbour the worm that causes the disease "trichinosis" in humans. The same parasite occurs in some wild animals. Certain tapeworm cysts occur in moose, deer, and domestic animals such as sheep and hogs, as well as in man. One known bacterial disease which affects man is also found in rabbits, beaver, and muskrats; and some viruses that cause disease in humans may have wild animals as reservoir hosts.

Research on the effects of parasites on their hosts requires a knowledge of the normal animal, especially a knowledge of the normal blood picture. Having accurate information on the normal blood state of the marten or raccoon, for example, should enable us to determine whether various parasites produce abnormal conditions in these animals. The identification of parasites occurring in various animals is also an essential part of the needed research.

The study of parasites is a large and complicated part of zoology. The Advisory Committee on Fisheries and Wildlife helps to co-ordinate the research being done in this field by the Ontario Research Foundation, where the study is concentrated, with related projects at the University of Toronto, the Royal Ontario Museum, and the Ontario Veterinary College.

## Plants in Relation to Wildlife

Wildlife problems cannot be successfully dealt with from the point of view of zoology alone. Some members of the Advisory Committee belong to a group which is interested in botanical studies of plants of importance to wild animals and birds. At the Royal Botanical Gardens at McMaster University, study has been chiefly centred in water and marsh types of plants such as wild rice and cat-tail. The Department of Lands and Forests has

been directing a study of plants which provide food and cover for field game such as the pheasant. A large quantity of multiflora rose stock and some varieties of lespedeza and other plants have been experimented with in order to improve habitat.

### **Co-ordination of Research in the Lake Erie Region**

Integration of research is an important part of the work of the Advisory Committee on Fisheries and Wildlife. Unnecessary duplication must be avoided and urgent problems must receive first attention. A co-operative program of research is being established in Rondeau Provincial Park. The research at this station will be conducted by the Ontario Department of Lands and Forests, the University of Western Ontario, and other interested agencies. The laboratory and physical facilities are to be established and administered by the Department of Lands and Forests. The University of Western Ontario will use the station as a base for biological research associated with their own problems. Much of the research carried out in the station will be directed towards the best use of the fisheries resources of Lake Erie. In addition, research on wildlife problems of importance to agriculture will be co-ordinated through the projected station.

### **Co-ordination with other Committees**

Research in such fields as forest insects, tree diseases, and soils is related to problems in fisheries and wildlife. The study of fisheries also includes such problems as the fertilization of water and the penetration of light into water, since the nutrients in water and the extent to which light penetrates are basic to the productivity of waters. The knowledge of variations in phosphate content of bottom soils of a lake, chemical compositions of lake bed deposits, yeasts in soils, and virus diseases in plants depends upon basic studies in biology having a wider application than to fisheries and wildlife. Co-ordination in both effort and results with the Committees dealing with agriculture and forestry is therefore a day-to-day necessity.

### **Libraries**

In any field of research the knowledge of what has been done is fundamental to continued investigation. There is an enormous literature in each of the areas of fisheries, wildlife, forestry, agriculture, and soils with which the investigator should be familiar when undertaking any piece of research, but there is much of this literature which concerns them only indirectly. Published information is being added to so rapidly that its organization is becoming a research problem in itself.

In the Ontario Fisheries Research Laboratory a large library has been built up through exchange with all the important freshwater fisheries

research stations in the world. The materials have been indexed and arranged for ready use. A subcommittee of the Advisory Committee on Fisheries and Wildlife was recently set up to go into the larger problem of accumulating, organizing, and indexing literature in all the biological fields related to fisheries and wildlife. A complete library service should be established in these fields and kept up-to-date.

### Annual Technical Session

During the year the full Committee met twice — in Toronto in November, 1951, and in Hamilton in February, 1952; and four meetings of the Executive were held.

One of the activities sponsored by the Committee is an annual Technical Session, held usually at the end of February. The Sixth Session was held at McMaster University. Previous Sessions have been held at University of Western Ontario, Queen's University, and University of Toronto. At these scientific meetings the results of research are presented, and members of the Advisory Committee can judge and qualify the research being carried on under grants from the Research Council. The Technical Sessions provide training for students who prepare and present research papers. Scientists can also compare the results and performance of workers in different laboratories; they can exchange information and opinions on problems of general interest. At the last meeting more than twenty members of the Ontario and Federal departments concerned with fisheries and wildlife were in attendance. Such interest in the Sessions taken by those responsible for the management of fisheries and wildlife helps to co-ordinate the efforts of the research scientists with those who can apply the results of research in management.

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- "A Fractionating Column to Provide Water of Various Dissolved Oxygen Content", F. E. J. Fry, Canadian Journal of Technology 29: 144-146. 1951



## ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: Mr. C. A. Pollock

It is the opinion of some capable observers that Canada is entering a period of great industrial expansion. Resources exist in this country for production on a much higher scale, and trends may shape an incalculable demand. If this prophecy is to be fulfilled enterprise and self-reliance will be needed. To a great extent this will express itself in an increased application of scientific knowledge to production.

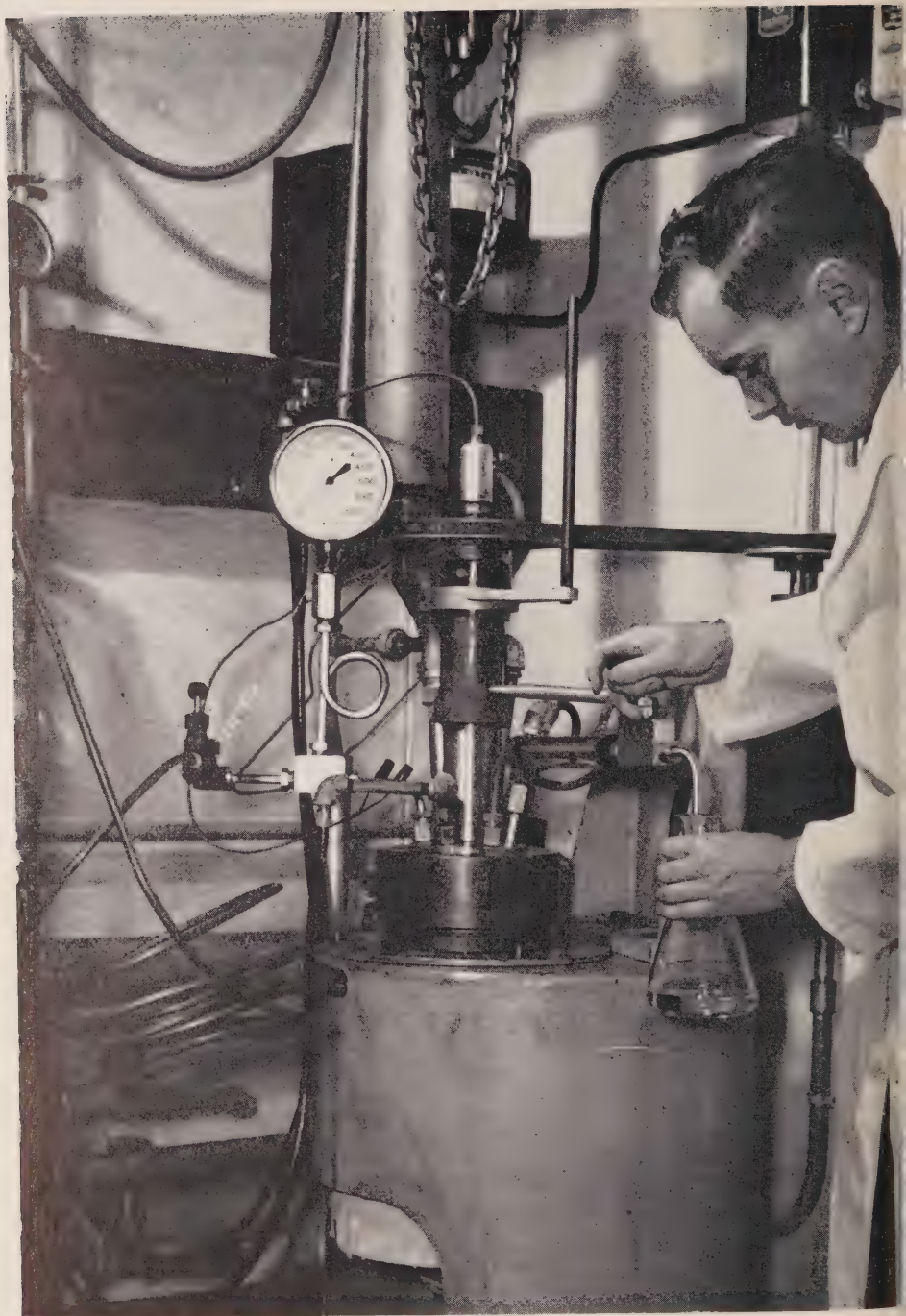
For most industrial processes, even for those not classified as highly technical, development depends on the use of scientific method, not necessarily "research" as such, but more often the application of known scientific facts. A more general confidence in the scientific approach to problems of production, particularly among smaller manufacturers, can come only through greater familiarity with its essential practicability. This job of encouragement is the main function of the Advisory Committee on Industrial Research.

During the year five meetings of the Advisory Committee were held. In the main activity has been devoted to two interests: (1) the work being done by the Industrial Research Services of the Ontario Research Foundation, and (2) encouragement of Group Research in industry.

### Industrial Research Services

This Department of the Ontario Research Foundation provides an extension or field service which brings together problems of industries throughout Ontario and the facilities of the Foundation and other research agencies. The Foundation is an experienced and well-equipped research plant designed for basic investigation as well as the solution of day-to-day technical problems. Now in its 24th year, it has divisions which are equipped and staffed for research and testing in the fields of chemistry, biochemistry, engineering and metallurgy, textiles, parasitology, physical geography, and mathematical statistics, yet the organization is flexible enough for a personal approach to the problems brought to it daily by large and small manufacturers alike.

The field engineers of the Industrial Research Services make introductory calls on manufacturers in order to acquaint industry with the services available. Supplying technical information in reply to questions from clients is a steadily increasing function of the field men, but with the limited staff now employed this is being done at the expense of introductory calls. A prime function of the Industrial Research Services is to provide facilities for the diagnosis of the real needs of the client. What may appear to be the problem is often only a symptom of the real cause. Even when a solution is foreseen, the interpretation of technical information to the



(Courtesy Ontario Department of Lands & Forests)

Using a high-pressure reactor, Engineering Laboratory, Ontario Research Foundation. The machine can operate at very high temperature and pressure (up to 300°C, 1,500 lbs. per sq. in.). It was used in extracting essential oils from pine needles.

advantage of small manufacturers who lack the technical help to apply it is a constant concern of the field engineers. Applying developmental plans to the needs of those plants often calls for much adjustment, demonstration, and explanation. The contact which the field men have with such organizations as the Trade and Industry Branch, the Industrial Development Bank, and marketing consultants often helps a manufacturer in other than technical ways.

The Director and staff of the Industrial Research Services are doing a sound job of selling to Ontario manufacturers the potential of scientific "know-how" invested in research. Since their merchandise is good, there has been a solid record of success. The original three territories of Ontario allotted to field engineers in 1947 had to be reduced in size because of the increased demand for services, and the number of territories increased to six. The growing confidence of clients is reflected in the rising percentage of repeat calls. In 1947, 81% of all calls were introductory and largely unsolicited, and about 19% were return visits to firms where interest had been established. In the intervening four years the proportion has been almost reversed. Notwithstanding the fast growth in volume of total calls — from less than 500 in 1947 to more than 3,600 in 1951 — the number of repeat calls by 1951 made up approximately 63% of all visits to industry. In addition, the average time that must be devoted to each call has increased because of the broader participation which the field engineers are invited to take in everyday problems of small manufacturers.

There have been some impressive expansions of industrial companies as a direct result of improved merchandise and more efficient production brought about by developments suggested and guided by the Industrial Research Services. Moreover, valuable assistance has been given to manufacturers at critical times when substantial losses were at stake. Information contained in scientific libraries and research reports, and the experience of government and university scientists are often made available to industry through the professional connections which the staff of the Industrial Research Services maintain with the scientific fraternity.

Indeed the success of the Industrial Research Services has created problems of its own. During 1951 seven senior members of the staff took attractive employment offers in industry or entered businesses of their own. Some replacements have been made with men of excellent calibre, but ground is lost in the turnover. To develop and hold an experienced staff may require payment of salaries more in line with what industry is now offering to engineers. It is conceded that Industrial Research Services helps its own cause by providing training and experience to young engineers who may later promote scientific management as employees of industry. It is, however, essential that the field engineers remain long enough to maintain an aggregate of experience in the staff high enough to obtain good results. At present the reduction in staff and the increased demand for services is making it difficult for the field men to perform any systematic coverage of their territories, and introductory calls are almost out of the question.



Staff shortage is offset in some degree by the closer integration which has developed with the private testing laboratory of the Ontario Research Foundation. Now work is more easily referred to those people in the laboratory who are best equipped to undertake it, and the facilities of the Foundation have been repeatedly expanded to meet new tasks. During the past year, for example, a number of mechanical engineers have been taken on the staff to answer the increasing demand from mechanical industries particularly in the field of heating and air conditioning.

The provision in the Foundation for a Cobalt 60 source for radiography of materials has added a very useful tool which is in frequent use. This work has been integrated with the resources of Isotope Products Ltd., Oakville, who have more elaborate facilities in the ranges beyond Cobalt 60. This present arrangement is quite a good one.

The Textile Short-Term Laboratory has increased its staff because of a 25% growth in work during the past year. In the Chemistry Department it has been necessary to increase staff from three to seven.

These increases represent a corresponding increase in the expenditure of money by smaller manufacturers to obtain the results of laboratory work, and it also proves that many industries are learning to use the facilities of the Foundation more profitably.

## Group Research

Considerable investigation and encouragement has been given to developing research projects sponsored by groups of companies interested in the same problems. The Research Council of Ontario Act provides that up to 50% of the cost of research undertaken by two or more companies may be borne by the Government. Although much interest has been evoked, it has been difficult to obtain the continuing support of manufacturers who could profit mutually by co-operative research.

There are two notable exceptions. In 1949 a group research project was commenced by three companies in the canning industry. The work has continued favourably, and the group now includes eleven companies. Members of the staff of the Ontario Research Foundation have visited the laboratories of the National Cannery Association in Washington this year to learn of their progress in research and to obtain equipment to test the effects of high temperatures on harmful organisms. It is planned to acquaint all canners in Ontario with the findings of the group to date, with the hope of stimulating others to join the work.

The second group which promises success is that of the American Electroplaters' Society. A project to study the effects of metal fabrication on electroplating is going forward.

The obligations in time and expense, though small, appear to be a discouraging factor to many manufacturers who otherwise favour the prin



ciple of group research. Moreover, a reluctance to co-operate with business competitors is inherent in private enterprise. Nevertheless, when a group project can be carried to the point where a technical development — not usually attainable by a single manufacturer — seems within reach, the larger value of the research becomes the incentive for joint effort. It is hoped that this position can be reached by an increasing number of the groups and associations who have shown their interest in research. As the number of successes grow the task will become easier.

The record of the Research Association Scheme in Great Britain provides abundant proof that small industries can solve their problems of development by mutual programs of research — and probably in no other way. At the outbreak of the 1914-18 War Britain found herself in a serious industrial position by comparison with Germany, where science had been more effectively applied to cheaper and better processes of manufacture. The weapons of industry had now become the weapons of war; and in the future scientific knowledge would be required for the arts of peace. In 1917 direction of research in Great Britain was incorporated in a new government department — the Department of Scientific and Industrial Research. The D.S.I.R. saw that far too little industrial research was being done in England. With encouragement it believed that large firms would finance their own scientific improvement. Research of a national application would have to be undertaken by the State. The real problem lay in a third area, that of the many small industries whose output made up the bulk of the nation's production.

A plan was worked out to provide financial and scientific aid by the government to any association of small firms seeking improvement through research. In spite of the difficult post-war years in Britain and the great depression of the 1930's, the research associations grew in strength, until at present there are approximately forty in operation financing about two-thirds of their own research costs. The quality of products was improved, production costs were lowered, and new products were developed. From the beginning the benefits of the total research effort well repaid the cost. In the case of some organizations the research meant survival; in others the yields were so high as to allow the development of entirely new industries.

The Industrial Committee of the Research Council of Ontario believes that group research now offers even greater opportunities in Ontario to utilize the physical and scientific resources of the Province in a practical and economical way. The Committee will continue to work to that end.

## ADVISORY COMMITTEE ON INDUSTRIAL WASTE

Chairman: Prof. A. C. Plewes

Anyone who has lived in the neighbourhood of a dairy or cannery is likely to be aware of the problem of waste disposal. Oil or chemical companies, tanneries, textile and paper companies are also offenders in greater or less degree depending on the efficiency of methods of waste disposal. In some localities rivers or lakes are polluted, with detriment to both fish life and public health. A Canadian-American commission has already studied contamination of boundary waters. With the increasing industrialization of Ontario since the War a greater quantity and variety of chemical wastes is flooded into the watercourses of the Province each year.

Assisted by information provided by the Ontario Department of Health, who have long been concerned with this problem, the study of industrial waste was resumed in 1947 when the Advisory Committee on Industrial Waste of the Research Council of Ontario was formed. Without exact technical direction for the handling of industrial wastes, laws respecting their disposal are difficult to implement. Since the problem is large and varied, it was decided to attack it by specific industries, rather than by localities. Dairies and canneries were first considered.

### Dairies

The processing of dairy products represents a sizable and widespread industry in Ontario, comprising over 1,500 operating units. Milk wastes contain many types of biochemicals which are contaminating to water. Many plants are operating in localities not provided with public sewage systems; 95% of dairies are in this class, over 50% of creameries, 70% of plants processing milk products. Typical disposal: large volumes of waste fluid discharged into inadequate septic tanks, open ditches, and small streams.

Some funds for research were provided through the Research Council of Ontario to the Department of Health. Two chemists and a student assistant investigated previous work done in the field, and conducted laboratory tests with a view to finding effective methods of disposal which are reasonably economical. This is being followed up by practical tests in dairies under normal conditions, using two different biochemical processes, the cost and efficiency of which will be compared. In one of the plants the owner has assumed half the cost of installing the equipment, and figures on the cost of waste disposal in this plant should be available by midsummer of 1952.

Meanwhile a number of waste disposal systems have been designed by the Department of Health Laboratories in response to requests from dairies and creameries. A "Plant Housekeeping" manual has been prepared for distribution to companies faced with similar waste material problems. The general problem would be reduced if small dairies could pool their

plants for cheaper disposal of wastes, a policy which the Department of Agriculture has advocated for some time.

### **Canneries**

Last year the Advisory Committee on Industrial Waste initiated programs of research in cannery wastes which were supported by the Research Council of Ontario. A study was made of five screening processes now in use to extract fruit and vegetable matter from waste water. Two other methods in present use, lagooning of cannery wastes, and precipitation, were also surveyed. Research in chemical precipitation is to be carried forward at some factories on a laboratory scale.

This preliminary work has aroused interest among the cannery operators, and the Committee is working on arrangements with the canning industry to organize group research on specific projects of waste disposal.

### **Chemical Wastes**

Some large chemical companies have asked the Department of Health for research assistance in the disposal of their phenolic and chlorinated phenolic substances. Members of the Advisory Committee have studied the progress made in this field by research agencies in the United States. The costs involved in present methods of disposal are high, and although a search is being made for cheaper supplies of chemicals to neutralize this type of substance, it is the opinion of the Committee that treating phenolic wastes economically will require more basic chemical research. The Committee therefore is looking into the possibility of encouraging the universities in Ontario to set up studies in the treatment of specific chemicals found in industrial waste. At present Queen's University has equipment available for testing methods of municipal sewage disposal. This equipment can be adapted to the study of certain types of industrial waste, and plans are under way to organize a testing program at Queen's University which may be integrated with the basic chemical studies.

The chemical industry has come to regard the disposal of waste as part of the whole problem of developing a product. For the purpose of using or disposing of waste in their various industries the Chemical Institute of Canada have organized a new division. The Committee on Industrial Waste of the Research Council of Ontario works in close co-operation with the Chemical Institute as well as with the Canadian Manufacturers' Association, and members of both these industrial organizations attend the meetings of the Committee in order to further integrate research knowledge and activity in industrial pollution.

The Canadian Manufacturers' Association have a Committee on Air Pollution. This Committee is seeking information on how to measure harmful air contamination in industrial areas and how to assist manufacturers in avoiding injury to the public.

The Research Council of Ontario has reason to hope that considerable success will result from co-operative effort with industry. At present three large companies at Sarnia are beginning a joint project with the Research Council on air and water pollution of the St. Clair River area. The Council can recommend government support of such group research up to 50% of the cost, the remaining 50% or more to be provided by the two or more co-operating companies. It is expected that the St. Clair River program may serve as a model for group research with industries in other areas.

Other urgent problems in chemical pollution which need scientific study are: waste from paper mills; petroleum wastes; chromic acid and cyanide pollution; and detergents and their effects on domestic sewage.

## Reports

"Progress Report — Milk Waste Research". R.C.O. Report 7-4-51, June, 1951.

"Progress Report — Milk Waste Research". November, 1951.

"Progress Report — Cannery Waste Survey". R.C.O. Report 7-3-51, June, 1951.

"Progress Report — Cannery Waste Survey". R.C.O. Report 7-5-51, November, 1951.



## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Mr. A. K. Hay

In Ontario during 1950 there were six times as many cars on the road as in 1920, and figures show that the average annual mileage for cars in 1950 was three times as great as in 1920. This means that from automobiles alone the highways of Ontario are sustaining 18 times the travel that they did in 1920. This comparison does not take into account the stresses resulting from the high speeds and braking power of the modern car or the greatly increased proportion of fast and heavy transport trucks and buses.

From an engineering point of view Ontario highways have not kept pace with the revolutionary developments in road transport that have grown up with the great advances of the automobile industry. During the 1920's and 1930's the public demand was for huge mileages of dustless and mudfree road surfaces. The demand was so vocal that the existing roads were usually surfaced with little regard for their alignment, width, or sight distances. Besides, there was not sufficient funds to surface many miles of highway and improve as well the basic structural features. As a result, many of our highways are now obsolete with respect to both traffic capacity and safety. Highway transportation now occupies an important segment of our national economy, and is becoming larger every year. Research in the fields of materials, design, construction, traffic engineering, and safety is urgently needed as a guide to the most effective expenditure of available funds.

Some influences which are encouraging research have been at work. The motoring public want improvements in highways, in traffic laws and their enforcement, and in the personal qualifications demanded for safe driving. The Ontario Good Roads Association has for years advocated highway improvement, and it was on their initiative that the Advisory Committee on Highways Research was formed in 1947. Large private corporations do some research on materials which they produce for road surfacing. Finally in problems of road construction the Testing and Soils Laboratories of the Ontario Department of Highways has been investigating a number of projects.

Research on highways, however, is hampered in two ways. One is the lack of a full recognition of the need. In Ontario current expenditure on highway research is about one-quarter of one percent of the total expenditures on highways. This is only one-eighth of the proportion spent by the United States Federal Government alone on American state highways.

Second, our highway research program in Ontario has been curtailed because of the absence of engineers trained in this field of research. None of the engineering schools in the Province does work in highway research. There is a serious shortage of highway engineers in every province of Canada. The Advisory Committee on Highways of the Research Council of Ontario believes that the importance of our roads justifies the establish-

ment of highway Engineering courses in our Ontario universities. The Committee also recommends that the University of Toronto and Queen's University be encouraged to undertake those highway research projects for which they are particularly well fitted.

Even for projects for which funds are now available it is difficult to attract and hold qualified research engineers in the universities and government departments. They are attracted by the higher salaries that can be paid by other organizations. For this reason a number of the studies which were to be undertaken last year have not been initiated. Some solution to this problem of technical personnel must be found before any large portion of the proposed highway research program can be effectively carried out.

### **Needed Highway Research**

The Research Division of the Ontario Department of Highways have projected a long-term program of essential investigation. The projects range from basic problems in types and supplies of materials to the more recently developed problems in highway designing which affect safety and the condition of drivers. Some of the more urgent subjects for research are (1) to develop designs for flexible pavements which will provide at the lowest ultimate cost adequate strength for the loads to be carried; (2) to set values for supporting subgrades and base courses that can be used in paving design; (3) to evolve designs for highway intersections, using methods of channelization for simplicity, safety, and the effective flow of traffic; and (4) to make a critical investigation of our present highway system in Ontario to obtain a sufficiency rating on such records as traffic volume, traffic density, and accidents as affected by gradients, curvature, sight distance, and surface conditions. The degree of progress in each project will depend largely on the qualified staff available.

## ADVISORY COMMITTEE ON MINES, MINERALS, AND METALLURGY

Chairman: Mr. N. F. Parkinson

### Ferrous Metallurgy

Research in this field has continued. The success of the Ontario Research Foundation in producing sponge iron in brick furnaces received considerable press notice last year. Out of this recent study of ferrous metallurgy two new investigations have arisen. One involves the fundamental relationship between stress and magnetism in metals, looking forward to new methods of testing strengths of iron and steel. The other is a problem in controlled density steel. This is to improve existing methods of producing pellets containing all the necessary carbon, lime, and ore to make up a complete charge for a blast furnace. Both investigations are continuing with support from the Research Council of Ontario.

During the year Professor Pidgeon at the University of Toronto initiated a program of fundamental research in production of metal vapours which is closely coordinated with metallurgical projects being conducted at the Ontario Research Foundation.

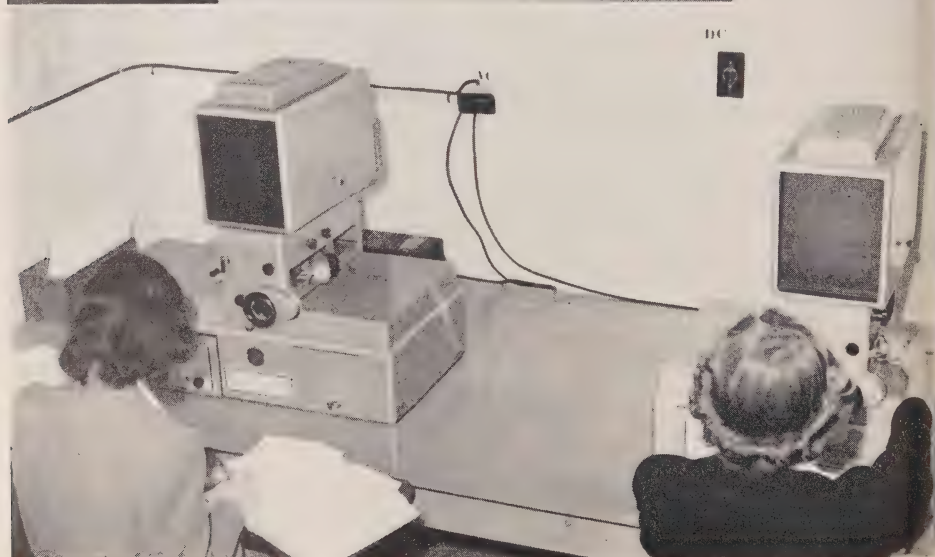
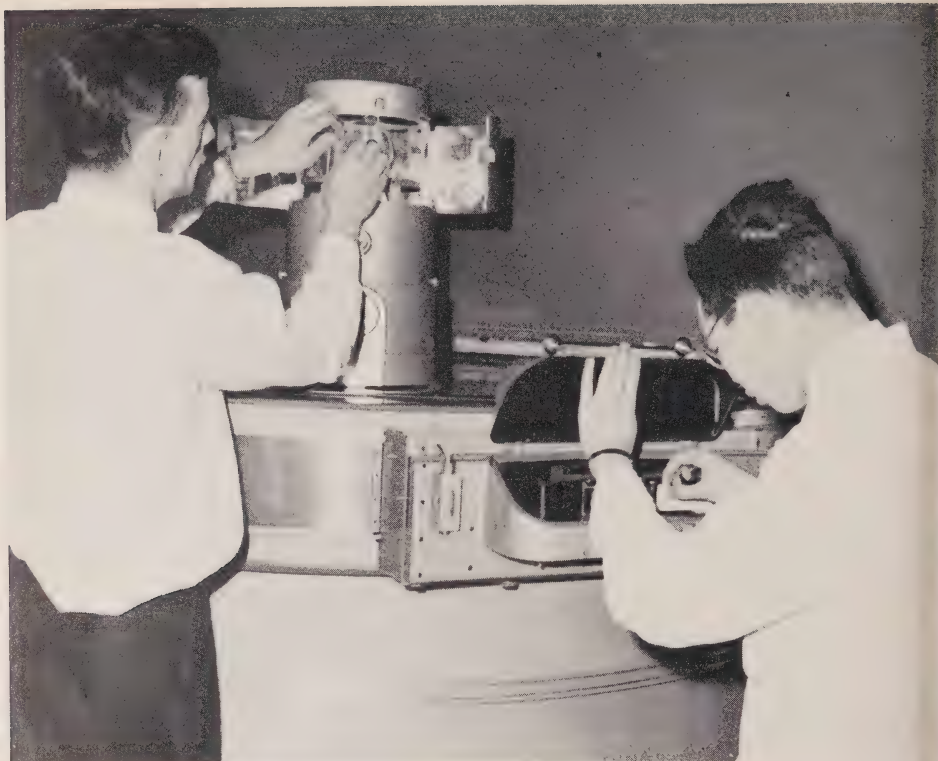
### Wire Rope

Research to improve the manufacture of hoisting cable and to develop methods of testing it under working conditions has continued. Reports on work done last year on the experimental machines of the Ontario Research Foundation seem to establish a definite relationship between the life of a wire rope and the rate of strain of the rope while in use. Considerable further experimentation may be needed before this relationship can be used in a practical way to estimate the remaining life of a rope. A supersonic method for testing wire rope in service is being studied as a group research project with the Ontario Mining Association. The McPhar Engineering Company are conducting the experiments. The method has been developed to a point where tests on ropes in service are being carried out. Ropes which are due for replacement in the shafts of some Ontario mines are tested by supersonic waves and examination graphs obtained. Following removal, the ropes are being examined in some detail by tensile tests at the Department of Mines. The two sets of results will be correlated to obtain any conclusions which may be useful.

### Geophysical Prospecting

A program to develop geophysical methods in the search for minerals is continuing at the University of Toronto under the direction of Professor J. T. Wilson and supported in part by the Research Council of Ontario.





(Courtesy Queen's University Public Relations)

Above, adjusting dryer for film and camera of mass spectrograph, Queen's University.

Below, reading films on comparator densitometers, Queen's University.

Spectrographic research is establishing techniques for analysis of trace elements in platinum, palladium, rhodium, and tungsten, or for studying the distribution of these metals in copper, iron and nickel sulphides.



Some impressive additions to the knowledge in this field are being made by this research group. The emphasis on geophysical prospecting is calling for so many trained scientists that it is difficult to maintain the basic research work in our universities. The same problem is encountered by Professor Hawley at Queen's University, who has been studying the use of the spectrograph in determining the presence of the platinum metals in ore and refinery products. His work has been so successful and the scientists trained in this work are in such demand that the research program has been maintained only with some difficulty.

Professor Misener at the University of Western Ontario has continued his work on the heat flow in the rocks of the Canadian Shield. Methods have been developed that will permit measurements to be taken more easily in the field. A probe is introduced into a drill hole, a known quantity of heat is supplied to the probe, and the resulting temperature changes in the probe can be related to the conductivity of the rock at the point where the probe is located.

### **Geology and Metallurgy**

A program to develop a technique for determining the constituents of alloys and minerals by means of polarography has been going forward under Professor Graham at McMaster University. New methods have been developed for the determination of titanium in steel, nickel-base, and aluminium-base alloys; and of aluminium in zinc-base alloys. The research is being extended to cover copper in aluminium base alloys, and aluminium in copper-base alloys.

A special study of ore bodies as they occur in larger parent rock formations will soon be completed by Professor W. H. Gross at the University of Toronto.

The great need for cobalt for alloys and, when made radioactive, for the treatment of disease and for testing materials is a matter of concern to the industries producing cobalt and to the Federal and Provincial Governments. A co-operative program between the Bureau of Mines at Ottawa, the cobalt producers and the Research Council of Ontario has been initiated with the aim of increasing production of this mineral.

### **Publications and Reports:**

"The Effects of Plastic Deformation on Magnetic Properties of Polycrystalline Metals", Ursula M. Martius, Can J. Physics 29: 21-31. January, 1951.

"Sponge Iron a Remedy for Scrap Shortage?", P. E. Cavanagh, Steel, 128: 92-101. 1951.

"The Tunnel Kiln Sponge Iron Process III", P. E. Cavanagh, Can. Ceram. Soc., J. 20: 47-72. 1951.

- "Determination of Titanium in Rocks and Minerals", R. P. Graham and J. A. Maxwell, *Analytical Chemistry*, Vol. 23, Page 1123, August, 1951.
- "Spectrographic Study of Platinum and Palladium in Common Sulphides and Arsenides of the Sudbury District, Ontario," J. E. Hawley, C. L. Lewis and W. J. Wark, *Economic Geology*, Vol. 46, No. 2, March-April, 1951.
- "Spark Analysis of Semi Microsamples", W. J. Wark, *Journal of the Optical Society of America*, Vol. 41, No. 7, pp. 465-67, July, 1951.
- "Summary Report on Spectrographic Research", J. E. Hawley, R.C.O. Report No. 8.5.51.
- "Approximate Solution of a Transient Heat Flow Problem" A. D. Misener *Proceedings of the Physical Society, A*, Vol. LXIV, P. 1132, 1951.
- "Terrestrial Heat Flow in Ontario and Quebec", A. D. Misener, L. G. D. Thompson and R. J. Uffen, *Transactions, American Geophysical Union* Vol. 32, No. 5, October, 1951.
- Report to the Research Council of Ontario on Geothermal Measurements, A. D. Misener, April 11, 1951.
- "Tidal Variations in Gravity", M. S. Reford, *Transactions, American Geophysical Union*, vol. 32, pp. 151-156, April, 1951.
- "A Modification of the Isotopic Lead Method for Determination of Geological Ages", C. B. Collins, J. R. Freeman and J. T. Wilson, *The Physical Review*, vol. 82, no. 6, pp. 966-967, June 15, 1951.
- "Comparisons of Gravitational and Magnetic Anomalies Over Certain Structures in Southeastern Ontario", G. D. Garland, *Trans, C.I.M.M.* vol. 54, pp. 340-345, 1951.
- "Geological Age Determinations in the Canadian Shield", C. B. Collins and J. R. Freeman, *Transactions, Royal Society of Canada*, vol. XLV, Ser. III June, 1951, pp. 23-30.
- "Terrestrial Heat Flow in England", E. C. Bullard and E. R. Niblett, *Mon. Not. Roy. Astron. Soc., Geoph. Supp.*, vol. 6, no. 4, pp. 222-238, 1951.
- "On the Growth of Continents," J. T. Wilson, *The Papers and Proceedings of the Royal Society of Tasmania*, December 15, 1951, pp. 85-111.
- "Physical Aspects of the Contraction Hypothesis of Orogenesis," A. E. Scheidegger, *Can. Jour. of Physics*, vol. 30, pp. 14-25, 1952.
- "Cyanogen Rarefaction Using Solid CO<sub>2</sub>", W. J. Wark, *Journal of the Optical Society of America*, vol. 41, no. 7, p. 482, 1951.
- "Spectro Chemical Analysis of Palladium and Platinum Sponge", J. E. Hawley, W. J. Wark, C. L. Lewis and W. L. Ott, *Trans. Canadian Institute of Mining and Metallurgy*, col. LIV, 1951, pp. 425-433.
- "Spectrographic Studies of Pyrite in some Eastern Canadian Gold Mines," J. E. Hawley, *Economic Geology*, vol. 47, no. 3, 1952.

## ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

**Chairman: Prof. K. B. Jackson**

The work of improving aerial photography and the interpretation of aerial photographs has been continued during the past year. The program of the Advisory Committee has not been formally extended, but on projects previously undertaken there has been continued co-operation between departments of the Provincial Government, the Applied Physics and Electrical Engineering Departments of the University of Toronto, the National Research Council, and industrial organizations. Further tests have proved the satisfactory adaptation of the radio altimeter to the problem of making safe landings on "glassy water". Improvement in the interpretability of aerial photographs is continuing, with studies in "unsharp masking" and the use of dispersive glasses designed to offset certain unfavourable effects produced by the human eye. Further research in the use of Wild A-5 equipment in aerial triangulation is proceeding with the co-operation of the Photographic Survey Corporation.

# APPENDIX I

## STATEMENT OF EXPENDITURE

### For the Year Ended 31st March, 1952

#### ADMINISTRATION:

Salaries .....	15,119.76	
Maintenance .....	4,096.48	
Travelling .....	5,493.74	24,709.98

#### SCHOLARSHIPS .....

49,485.00

#### GROUP RESEARCH (Government share, 50%) .....

19,448.40

#### GRANTS:

##### Ontario Research Foundation:

Wire Rope .....	14,759.85	
Ferrous Metallurgy .....	29,911.46	
Parasitology .....	36,343.78	
Wood Chemistry .....	40,476.77	
Physiography .....	19,662.62	
Utilization of Agricultural Products .....	12,540.40	
Industrial Research Services .....	74,820.13	
Physics of Metals .....	8,490.76	
Controlled Density Steel .....	5,000.00	
Group Research Development .....	4,537.37	246,543.14

##### University of Toronto

Fisheries and Wildlife .....	31,860.00	
Mines .....	13,920.00	
Forestry .....	32,160.00	
Aerial Survey .....	3,000.00	
Agriculture .....	3,600.00	84,540.00

##### McMaster University

Fisheries and Wildlife .....	15,240.00	
Forestry .....	2,400.00	
Mines .....	2,160.00	19,800.00

##### Queen's University

Fisheries .....	8,400.00	
Mines .....	2,400.00	
Forestry .....	12,240.00	23,040.00

##### University of Western Ontario

Fisheries and Wildlife .....	13,620.00	
Mines .....	5,280.00	18,900.00

##### Ontario Agricultural College

Agriculture .....	10,750.00	10,750.00
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##### Department of Health

Milk Waste .....	9,867.81	9,867.81
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##### Department of Lands and Forests

Forestry .....	10,250.00	10,250.00	423,690.90
			517,334.30



## APPENDIX II

### SCHOLARSHIP AWARDS — 1951-52

Name	Field	Scholarship University	Amount
DAMEK, S.	Chemistry	McGill University	\$ 700.00
DLINGTON, R. H.	Physics	University of Western Ontario	600.00
NDERSON, R. C.	Biology	University of Toronto	700.00
ZIZ, R. A.	Physics	University of Toronto	700.00
ACK, R. A.	Chemistry	McGill University	700.00
ENDELL, J. F. S.	Biology	University of British Columbia	700.00
ERRY, R. J.	Physics	Queen's University	600.00
EST, E. W.	Geology	Wisconsin University	700.00
EDWELL, R. G. S.	Biology	Queen's University	700.00
ROWNELL, H. H.	Chemistry	McGill University	700.00
HAPPEL, C. I.	Veterinary Science	McGill University	700.00
DLHOUN, E. H.	Biology	Cambridge University (plus travel grant)	700.00 250.00
OOK, F. S.	Biology	University of Toronto	700.00
RANNA, N. G.	Physics	University of British Columbia	900.00
REIGHTON, S. M.	Chemistry	Yale University	900.00
ONNELLY, R. J.	Physics	McMaster University	600.00
UBECK, M.	Chemistry	McMaster University	600.00
UNN, D. W.	Mathematics	Massachusetts Institute of Technology	900.00
OWARDS, M. H.	Physics	University of Toronto	750.00
OWARDS, W. J.	Chemistry	McMaster University	600.00
AWCETT, D. M.	Chemistry	McMaster University	600.00
ERN, G. R. H.	Chemistry	McMaster University	600.00
EMING, W. H.	Physics	McMaster University	700.00
EIGER, J. S.	Physics	McMaster University	600.00
RIFFITHS, G. M.	Physics	University of British Columbia	900.00
HAMILTON, D. R.	Physics	University of British Columbia	700.00
MURD, R. A.	Mathematics	University of Toronto	700.00
PERSON, K. E.	Mathematics	Harvard University	700.00
CKSON, MISS M. F.	Biology	University of British Columbia	700.00
ONES, R. E.	Geology	University of Toronto	700.00
NOTT, R. F.	Engineering	University of Toronto	750.00
BIN, M. L.	Biology	University of Toronto	700.00
NDSEY, C. C.	Biology	Cambridge University	900.00
OKKEN, J. E.	Physics	University of Western Ontario	600.00
KAY, C. D.	Mathematics	McGill University	700.00
MULLEN, C. C.	Physics	McMaster University	900.00
MARTINO, R. L.	Mathematics	University of Toronto	600.00
WILKS, J. E.	Chemistry	McGill University	900.00
WILLAR, R. F.	Mathematics	University of Toronto	600.00
ELSON, C. D.	Biology	Queen's University	600.00
WON, W. C.	Physics	Cambridge University	900.00
ARSON, A.	Physics	University of Toronto	900.00
TCH, H. E.	Physics	University of British Columbia	900.00

Name	Field	Scholarship University	Amount
RIGLER, F. H.	Biology	University of Toronto	700.00
SALKELD, MISS E. H.	Biology	London University	1,000.00
SEMPLE, R. J.	Mathematics	Princeton University	700.00
SHARMAN, L. J.	Chemistry	University of Saskatchewan	700.00
SHEPPARD, W. A.	Chemistry	Massachusetts Institute of Technology	700.00
SHOEMAKER, R. A.	Biology	Ontario Agricultural College	700.00
SMILLIE, L. B.	Biochemistry	University of Toronto	700.00
SMITH, E. H. N.	Biology	University of Illinois	700.00
SONES, R. H.	Chemistry	McMaster University	600.00
STEPHENSON, F. C.	Physics	University of Toronto	900.00
STOTHERS, S. C.	Biology	University of Michigan	600.00
STRICKLAND, K. P.	Biochemistry	University of Western Ontario	900.00
SWITZER, C. M.	Biology	Ontario Agricultural College	600.00
TROLLOPE, F. H.	Geology	University of Toronto	600.00
UFFEN, R. J.	Physics	University of Western Ontario	900.00
VERSTEEG, J.	Chemistry	McGill University	900.00
VITTORIO, P. V.	Biology	Queen's University	900.00
VOGAN, E. L.	Physics	McGill University	900.00
WALKER, J. F.	Chemistry	University of Illinois	1,000.00
WELCH, H. E.	Biology	University of Toronto	600.00
WERTHEIM, D. G.	Mathematics	University of Toronto	900.00
WILLIAMS, R. L.	Physics	University of British Columbia	600.00
WILSON, D. G.	Biochemistry	University of Wisconsin	1,000.00
WOOLVERTON, R. S.	Geology	McGill University	900.00

## APPENDIX III

### ADVISORY COMMITTEES

#### AERIAL SURVEY RESEARCH

##### Main Committee:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
(Chairman)		
MR. J. R. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Ontario Dept. of Lands and Forests
MR. J. A. BRODIE	- -	Ontario Dept. of Lands and Forests
MR. L. J. CHAPMAN	- -	Ontario Research Foundation
DR. W. CLARK	- -	Eastman Kodak Co.
DR. D. R. DERRY	- -	Ventures Limited
MR. W. J. FULTON	- -	Ontario Dept. of Highways
DR. L. E. HOWLETT	- -	Physics, National Research Council
MR. M. E. HURST	- -	Ontario Dept. of Mines
MR. W. J. JACKSON	- -	Williamson Co. of Canada, Ltd.
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. S. T. B. LOSEE	- -	Abitibi Power and Paper Co. Ltd.
PROF. O. J. MARSHALL	- -	Civil Engineering, University of Toronto
PROF. F. F. MORWICK	- -	Soils, Ontario Agricultural College
PROF. J. E. REID	- -	Electrical Engineering, University of Toronto
MR. A. H. RICHARDSON	- -	Ontario Dept. of Planning and Development
MR. J. R. G. SMYTH	- -	Ontario Dept. of Lands and Forests

##### Executive:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
(Chairman)		
MR. W. J. FULTON	- -	Ontario Dept. of Highways
MR. M. E. HURST	- -	Ontario Dept. of Mines
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. A. H. RICHARDSON	- -	Ontario Dept. of Planning and Development

##### Meetings:

May 9th, 1951, 39 Queen's Park, Toronto.

March 27th, 1952, 39 Queen's Park, Toronto.

##### PHOTOGRAPHY:

MR. J. R. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Ontario Dept. of Lands and Forests
PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation

##### PHOTOGRAMMETRY:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. K. H. SIDDALL	- -	Ontario Dept. of Highways
MR. L. G. TIMPSON	- -	Ontario Dept. of Lands and Forests
PROF. W. M. TREADGOLD	- -	Civil Engineering, University of Toronto
MR. J. G. WILKINSON	- -	Photographic Survey Corporation

## AGRICULTURAL RESEARCH<sup>1</sup>

### Main Committee:

PROF. G. N. RUHNKE	- -	Ontario Dept. of Agriculture
(Chairman)		
MR. A. M. BARR	- - -	Agricultural School, Kemptville
DR. W. H. COOK	- - -	Applied Biology, National Research Council
DR. W. P. DOBSON	- - -	Hydro-Electric Power Commission of Ontario
MR. J. A. GARNER	- - -	Ontario Dept. of Agriculture
MR. C. D. GRAHAM	- - -	Ontario Dept. of Agriculture
DR. E. S. HOPKINS	- - -	Dominion Dept. of Agriculture
DR. T. L. JONES	- - -	Ontario Veterinary College
DR. J. D. MacLACHLAN	- -	Ontario Agricultural College
MR. V. S. MILBURN	- -	Ontario Federation of Agriculture
DR. K. W. NEATBY	- -	Science Service, Dominion Dept. of Agriculture
DR. E. F. PALMER	- - -	Horticultural Experiment Station, Vineland
DR. H. B. SPEAKMAN	- -	Ontario Research Foundation
MR. J. C. STECKLEY	- - -	Western Ontario Experimental Farm, Ridgetown
MR. H. CRAISE	- - -	St. Catharines
MR. R. H. JARDINE	- - -	Ontario Dairy Producers' Co-ordinating Board
MR. C. F. LUCKHAM	- - -	Norfolk Specialty Farms

### Meetings:

January 21st, 1952, Royal York Hotel, Toronto.

## FISHERIES AND WILDLIFE RESEARCH

### Main Committee:

DR. J. R. DYMOND	- - -	Zoology, University of Toronto
(Chairman)		
DR. A. M. FALLIS	- - -	Parasitology, Ontario Research Foundation
(Secretary)		
DR. H. I. BATTLE	- - -	Zoology and Applied Biology, University of Western Ontario
MR. GEORGE BISHOP	- -	Northern Ontario Outfitters' Association
DR. A. O. BLACKHURST	- -	Ontario Federation of Commercial Fishermen
DR. C. H. D. CLARKE	- -	Ontario Dept. of Lands and Forests
PROF. A. F. COVENTRY	- -	Zoology, University of Toronto
DR. H. W. CURRAN	- - -	Biology, Queen's University
MR. C. D. FOWLE	- - -	Ontario Dept. of Lands and Forests
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. W. J. K. HARKNESS	- -	Ontario Dept. of Lands and Forests
MR. L. HUGHES	- - -	Northern Ontario Outfitters' Association
DR. F. P. IDE	- - -	Zoology, University of Toronto
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MR. CARL F. KOLBE	- - -	Ontario Federation of Commercial Fishermen
DR. R. R. LANGFORD	- -	Zoology, University of Toronto
MR. H. H. MacKAY	- - -	Ontario Dept. of Lands and Forests
MR. K. M. MAYALL	- - -	Ontario Dept. of Planning and Development
MR. W. AUSTIN PETERS	- -	Ontario Federation of Anglers and Hunters
DR. N. W. RADFORTH	- -	Botany, McMaster University
DR. DAVID SCOTT	- - -	Zoology and Applied Biology, University of Western Ontario
MR. LESTER L. SNYDER	- -	Royal Ontario Museum of Zoology
DR. F. A. URQUHART	- -	Royal Ontario Museum of Zoology

<sup>1</sup> The Agricultural Committee was re-organized January, 1952.



**Meetings:**

November 3rd, 1951, 39 Queen's Park, Toronto.

February 21st, 1952, Royal Connaught Hotel, Hamilton.

**Executive:**

DR. J. R. DYMOND	- - -	Zoology, University of Toronto
(Chairman)		
DR. A. M. FALLIS	- - -	Parasitology, Ontario Research Foundation
(Secretary)		
PROF. A. F. COVENTRY	- - -	Zoology, University of Toronto
DR. H. W. CURRAN	- - -	Biology, Queen's University
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. W. J. K. HARKNESS	- - -	Ontario Dept. of Lands and Forests
MR. R. N. JOHNSTON	- - -	Ontario Dept. of Lands and Forests

**Meetings:**

April 7th, 1951, 39 Queen's Park, Toronto.

May 21st, 1951; 39 Queen's Park, Toronto.

July 21st, 1951, Wildlife Station, Algonquin Park.

September 10th, 1951, McMaster University, Hamilton.

October 30th, 1951, 39 Queen's Park, Toronto.

January 31st, 1952, 39 Queen's Park, Toronto.

March 29th, 1952, 39 Queen's Park, Toronto.

**GREAT LAKES FISHERIES RESEARCH:**

MR. R. N. JOHNSTON	- - -	Ontario Dept. of Lands and Forests
(Chairman)		
DR. A. O. BLACKHURST	- - -	Ontario Federation of Commercial Fishermen
DR. J. R. DYMOND	- - -	Zoology, University of Toronto
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. W. J. K. HARKNESS	- - -	Ontario Dept. of Lands and Forests

**Publicity:**

MR. K. M. MAYALL	- - -	Ontario Dept. of Planning and Development
(Chairman)		
MR. A. FENWICK	- - -	Ontario Dept. of Lands and Forests
DR. N. W. RADFORTH	- - -	Botany, McMaster University

**Meetings:**

A number of informal meetings were held.

**RESEARCH ON PLANTS IN RELATION TO WILDLIFE:**

MR. C. D. FOWLE	- - -	Ontario Dept. of Lands and Forests
(Chairman)		
DR. W. J. K. HARKNESS	- - -	Ontario Dept. of Lands and Forests
MR. K. M. MAYALL	- - -	Ontario Dept. of Planning and Development
DR. N. W. RADFORTH	- - -	Botany, McMaster University
DR. J. H. SOPER	- - -	Zoology, University of Toronto

**Meetings:**

October 9th, 1951, Toronto.

**RESEARCH ON PARASITES AND DISEASES IN RELATION TO FISHERIES AND WILDLIFE:**

DR. A. M. FALLIS	- - -	Parasitology, Ontario Research Foundation
(Chairman)		
DR. C. H. D. CLARKE	- - -	Ontario Dept. of Lands and Forests
MR. C. D. FOWLE	- - -	Ontario Dept. of Lands and Forests

DR. A. A. KINGSCOTE	- -	Ontario Veterinary College
DR. J. F. A. SPRENT	- -	Ontario Research Foundation
DR. F. A. URQUHART	- -	Royal Ontario Museum of Zoology

#### Meetings:

A number of informal meetings were held.

## FORESTRY RESEARCH

#### Main Committee:

DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
(Chairman)		
DR. H. B. MARSHALL	- -	Ontario Research Foundation
(Secretary)		
MR. A. S. L. BARNES	- -	Ontario Dept. of Planning and Development
DR. JOHN E. BIER	- -	Dominion Dept. of Agriculture
(Associate Member)		
MR. G. G. COSENS	- -	Kimberley-Clark Corporation
MR. G. W. PHIPPS	- -	Kimberley-Clark Corporation
(Alternate to Mr. Cosens)		
MR. W. A. DELAHEY	- -	Consulting Forester
PROF. C. G. E. DOWNING	- -	Ontario Dept. of Agricultural Engineering
PROF. G. H. DUFF	- -	Botany, University of Toronto
MR. T. L. DUNBAR	- -	Consultant, Forest Utilization
PROF. R. O. EARL	- -	Biology, Queen's University
MR. D. A. GILLIES	- -	Gillies Bros. & Co. Ltd.
MR. J. H. GODDEN	- -	Great Lakes Paper Company
MR. J. D. B. HARRISON	- -	Dominion Dept. of Resources and Development
DR. O. HOLDEN	- -	Hydro-Electric Power Commission of Ontario
PROF. R. C. HOSIE	- -	Forestry, University of Toronto
COL. J. H. JENKINS	- -	Dominion Dept. of Resources and Development
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MAJ. GEN. H. KENNEDY	- -	Consulting Engineer
MR. A. KOROLEFF	- -	Pulp and Paper Research Institute of Canada
MR. W. J. LeCLAIR	- -	Canadian Lumbermen's Association
DR. G. A. LEDINGHAM	- -	National Research Council Regional Laboratory, Saskatoon
MR. A. P. LESLIE	- -	Ontario Dept. of Lands and Forests
MR. D. A. MACDONALD	- -	Dominion Dept. of Resources and Development
MR. J. B. MATTHEWS	- -	Abitibi Power and Paper Company Ltd.
MR. T. A. McELHANNEY	- -	Grimsby
PROF. R. R. McLAUGHLIN	- -	Chemical Engineering, University of Toronto
MR. C. R. MILLS	- -	Ontario Forest Industries Association
DR. M. L. PREBBLE	- -	Dominion Dept. of Agriculture
MR. K. O. ROOS	- -	Booth Lumber Limited
MR. S. J. STANFORTH	- -	Staniforth Lumber Co. Limited
DR. G. H. TOMLINSON, II	- -	Howard Smith Paper Mills Limited
MR. G. TUNSTELL	- -	Dominion Dept. of Resources and Development
(Associate Member)		
DR. L. T. WHITE	- -	Dominion Laboratory of Forest Pathology

#### Meetings:

May 28th to 31st, 1951, Kapuskasing.

October 26th and 27th, 1951, Southern Research Station, Maple, and  
Faculty of Forestry, University of Toronto.

**Executive:**

DEAN J. W. B. SISAM (Chairman)	- -	Forestry, University of Toronto
DR. H. B. MARSHALL (Secretary)	- -	Ontario Research Foundation
MR. A. S. L. BARNES	- -	Ontario Dept. of Planning and Development
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
MR. J. B. MATTHEWS	- -	Abitibi Power and Paper Company Ltd.
PROF. R. R. McLAUGHLIN	-	Chemical Engineering, University of Toronto

**Meetings:**

April 18th, 1951, 39 Queen's Park, Toronto.

December 5th, 1951, 39 Queen's Park, Toronto.

February 6th, 1952, 39 Queen's Park, Toronto.

**FIRE CONTROL:**

MR. J. B. MATTHEWS (Chairman)	- -	Abitibi Power and Paper Company Ltd.
MR. M. H. BAKER	- -	Ontario Dept. of Lands and Forests
MR. A. S. L. BARNES	- -	Ontario Dept. of Planning and Development
MR. J. C. DILLON	- -	Ontario Dept. of Lands and Forests
MR. Q. F. HESS	- -	Ontario Dept. of Lands and Forests
MR. R. N. JOHNSTON	- -	Ontario Dept. of Lands and Forests
PROF. A. S. MITCHELL	- -	Forestry, University of Toronto
MR. JAMES RUXTON	- -	Ontario Dept. of Lands and Forests
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto

**Meetings:**

July 4th, 1951, Southern Research Laboratory, Maple.

**WOOD CHEMISTRY:**

DR. H. B. MARSHALL (Chairman)	- -	Ontario Research Foundation
DR. G. A. ADAMS	- -	Applied Biology, National Research Council
DR. F. BENDER	- -	Forest Products Laboratory
DR. G. A. LEDINGHAM	- -	National Research Council Regional Laboratory, Saskatoon
PROF. R. R. McLAUGHLIN	-	Chemical Engineering, University of Toronto
DR. G. H. TOMLINSON, II	-	Howard Smith Paper Mills Limited

**Meetings:**

September 15th, 1951, 39 Queen's Park, Toronto.

**FOREST BIOLOGY:**

MR. A. P. LESLIE (Chairman)	- -	Ontario Dept. of Lands and Forests
MR. A. B. BAIRD	- -	Dominion Dept. of Agriculture
MR. G. G. COSENS	- -	Kimberley-Clark Corporation
MR. G. W. PHIPPS (Alternate to Mr. Cosens)	- -	Kimberley-Clark Corporation
MR. W. A. DELAHEY	- -	Consulting Forester
PROF. G. H. DUFF	- -	Botany, University of Toronto
PROF. R. O. EARL	- -	Biology, Queen's University
PROF. R. C. HOSIE	- -	Forestry, University of Toronto
MR. R. N. JOHNSTON	-	Ontario Dept. of Lands and Forests
MAJ. GEN. H. KENNEDY	-	Consulting Engineer

MR. D. A. MACDONALD	- - -	Dominion Dept. of Resources and Development
MR. C. R. MILLS	- - -	Ontario Forest Industries Association
MR. K. O. ROOS	- - -	Booth Lumber Limited
DEAN J. W. B. SISAM	- - -	Forestry, University of Toronto
MR. W. E. WILLSON	- - -	Abitibi Power and Paper Company Ltd.

#### Meetings:

April 2nd, 1951, Southern Regional Laboratory, Maple.  
January 28th, 1952, 39 Queen's Park, Toronto.

#### SAWMILLING PRACTICE:

MR. W. J. LeCLAIR	- - -	Canadian Lumbermen's Association
(Chairman)		
COL. J. H. JENKINS	- - -	Dominion Dept. of Resources and Development
DR. H. B. MARSHALL	- - -	Ontario Research Foundation
MR. T. A. McELHANNEY	- - -	Grimsby
MR. K. O. ROOS	- - -	Booth Lumber Limited
MR. J. F. SHARPE	- - -	Ontario Dept. of Lands and Forests
DEAN J. W. B. SISAM	- - -	Forestry, University of Toronto
MR. S. J. STANIFORTH	- - -	Staniforth Lumber Co. Limited
MR. G. J. THOMSON	- - -	Peter Thomson & Sons

#### Meetings:

November 20th, 1951, 39 Queen's Park, Toronto.

#### WASTE SLABWOOD UTILIZATION:

DEAN J. W. B. SISAM	- - -	Forestry, University of Toronto
(Chairman)		
DR. H. B. MARSHALL	- - -	Ontario Research Foundation
(Secretary)		
MR. JAS. W. CHURCH	- - -	Mechanical Engineering, University of Toronto
MR. W. J. LeCLAIR	- - -	Canadian Lumbermen's Association
PROF. W. G. McINTOSH	- - -	Mechanical Engineering, University of Toronto
COL. J. H. JENKINS	- - -	Dominion Dept. of Resources and Development
MR. T. A. McELHANNEY	- - -	Grimsby
PROF. I. W. SMITH	- - -	Mechanical Engineering, University of Toronto

#### Meetings:

November 20th, 1951, 39 Queen's Park, Toronto.

#### HIGHWAYS RESEARCH

##### Main Committee:

MR. A. K. HAY	- - -	Federal District Commission
(Chairman)		
MR. H. N. LAMONT	- - -	Ontario Dept. of Highways
(Secretary)		
MR. T. N. CARTER	- - -	Carter Construction Co. Ltd.
MR. L. J. CHAPMAN	- - -	Physiography, Ontario Research Foundation
MR. W. A. CLARKE	- - -	Ontario Dept. of Highways
MR. D. J. EMREY	- - -	County Engineer, Kitchener
MR. T. F. FRANCIS	- - -	Ontario Dept. of Highways
MR. W. J. FULTON	- - -	Ontario Dept. of Highways
MR. W. B. HASTINGS	- - -	Ontario Motor League



MR. R. A. LOW	-	-	-	Dominion Dept. of Resources and Development
MR. P. McCANN	-	-	-	Toronto Transportation Commission
MR. W. S. McKAY	-	-	-	Ontario Good Roads Association
DR. N. W. McLEOD	-	-	-	Imperial Oil Limited
MR. W. J. MOORE	-	-	-	Ontario Municipal Board
MR. F. L. PECKOVER	-	-	-	Building Research, National Research Council
MR. C. A. ROBBINS	-	-	-	Ontario Dept. of Highways
MR. D. O. ROBINSON	-	-	-	Canada Cement Co.
PROF. W. L. SAGAR	-	-	-	Civil Engineering, University of Toronto
MR. J. WALTER	-	-	-	Ontario Dept. of Highways
MR. R. B. YOUNG	-	-	-	Hydro-Electric Power Commission of Ontario
MR. J. L. SHEARER	-	-	-	Ottawa Suburban Roads Commission
(ex officio)				
MR. T. L. MOFFATT	-	-	-	Dibblee Construction Co.
(ex officio)				

#### Meetings:

April 13th, 1951, 39 Queen's Park, Toronto.

February 29th, 1952, Lecture Room, Ontario Research Foundation.

#### Executive:

MR. A. K. HAY	-	-	-	Federal District Commission
(Chairman)				
MR. H. N. LAMONT	-	-	-	Ontario Dept. of Highways
(Secretary)				
MR. D. J. EMREY	-	-	-	County Engineer, Kitchener
MR. T. F. FRANCIS	-	-	-	Ontario Dept. of Highways
MR. W. J. FULTON	-	-	-	Ontario Dept. of Highways
DR. N. W. McLEOD	-	-	-	Imperial Oil Limited
PROF. W. L. SAGAR	-	-	-	Civil Engineering, University of Toronto
MR. J. WALTER	-	-	-	Ontario Dept. of Highways

#### Meetings:

February 11th, 1952, 39 Queen's Park, Toronto.

February 29th, 1952, 39 Queen's Park, Toronto.

#### TRAFFIC AND PLANNING:

MR. W. J. FULTON	-	-	-	Ontario Dept. of Highways
(Chairman)				
MR. A. E. K. BUNNELL	-	-	-	Ontario Dept. of Planning and Development
MR. W. A. CLARKE	-	-	-	Ontario Dept. of Highways
MR. R. A. LOW	-	-	-	Dominion Dept. of Resources and Development
MR. G. R. MARSTON	-	-	-	County Engineer, Simcoe
MR. J. M. MacINNIS	-	-	-	Ontario Dept. of Highways
MR. J. L. ZOLLER	-	-	-	Ontario Dept. of Highways

#### DESIGN:

MR. D. J. EMREY	-	-	-	County Engineer, Kitchener
(Chairman)				
MR. T. F. FRANCIS	-	-	-	Ontario Dept. of Highways
MR. R. M. LEE	-	-	-	County Engineer, Brantford
DR. N. W. McLEOD	-	-	-	Imperial Oil Limited
MR. D. G. RAMSAY	-	-	-	Ontario Dept. of Highways
MR. D. O. ROBINSON	-	-	-	Canada Cement Co.
MR. J. WALTER	-	-	-	Ontario Dept. of Highways

## SOILS AND FOUNDATIONS:

MR. J. WALTER	- - -	Ontario Dept. of Highways
(Chairman)		
MR. D. J. EMREY	- - -	County Engineer, Kitchener
MR. R. A. LOW	- - -	Dominion Dept. of Resources and Development
MR. A. D. MCGINNIS	- - -	McGinnis and O'Connor
DR. N. W. McLEOD	- - -	Imperial Oil Limited
MR. D. G. WATT	- - -	Hydro-Electric Power Commission of Ontario

## MATERIALS AND CONSTRUCTION:

MR. D. O. ROBINSON	- -	Canada Cement Co.
(Chairman)		
MR. T. F. FRANCIS	- - -	Ontario Dept. of Highways
MR. C. FRASER	- - -	Ontario Dept. of Highways
MR. E. W. JONES	- - -	County Engineer, Barrie
MR. R. KELLY	- - -	W. L. Ballentine Co. Ltd.
MR. J. A. KNIGHT	- - -	Brunner Mond Canada Sales, Ltd.
MR. H. N. LAMONT	- - -	Ontario Dept. of Highways
MR. J. LANGMAN	- - -	King Paving Company Limited
MR. J. V. LUDGATE	- - -	Ontario Dept. of Highways
MR. B. MATSON	- - -	Ontario Rock Ltd.
DR. N. W. McLEOD	- - -	Imperial Oil Limited
PROF. W. L. SAGAR	- - -	Civil Engineering, University of Toronto
MR. C. G. SAUNDERS	- - -	Ontario Dept. of Highways
MR. J. WALTER	- - -	Ontario Dept. of Highways

### Meetings:

May 1st, 1951, 39 Queen's Park, Toronto.

August 27th, 1951, 39 Queen's Park, Toronto.

## INDUSTRIAL RESEARCH

### Main Committee:

MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries, Ltd.
(Chairman)		
MR. LORNE C. ANDERSON	-	Ontario Paper Co. Limited
MR. G. C. BERNARD	- -	Canadian Manufacturers' Association Inc.
MR. LORNE S. CAMPBELL	-	Ontario Dept. of Planning and Development
MR. HOWARD CHAMBERLAIN	-	Lowe Brothers Co. Ltd.
MR. T. A. FAUST	- - -	Yocum Faust, Limited
MR. R. W. KEELEY	- - -	Bendix-Eclipse of Canada Limited
COL. F. J. LYLE	- - -	Ontario Dept. of Planning and Development
COL. D. F. MacRAE	- - -	Ontario Research Foundation
MR. D. ALAN PAGE	- - -	Mercury Mills Limited
MR. T. V. PROCTOR	- - -	Libby, McNeill & Libby of Canada Limited
DR. H. B. SPEAKMAN	- -	Ontario Research Foundation
MR. W. R. STADELMAN	- -	Ontario Research Foundation
MR. D. W. STEWART, JR.	-	Renfrew
MR. D. B. STRUDLEY	- -	Imperial Furniture Mfg. Co. Limited
MR. J. N. SWINDEN	- - -	Great Lakes Lumber and Shipping, Ltd.
MR. KERGAN WELLS	- - -	W. W. Wells, Limited

### Meetings:

April 11th, 1951, Royal York Hotel, Toronto.

June 20th, 1951, King Edward Hotel, Toronto.

September 19th, 1951, King Edward Hotel, Toronto.

November 14th, 1951, Hart House, Toronto.

January 23rd, 1952, Royal York Hotel, Toronto.

## INDUSTRIAL WASTE RESEARCH

### Main Committee:

PROF. A. C. PLEWES	- - -	Chemical Engineering, Queen's University (Chairman)
DR. A. E. BERRY	- - -	Ontario Dept. of Health
MR. G. A. H. BURN	- - -	Ontario Dept. of Health
MR. A. V. DeLAPORTE	- - -	Ontario Dept. of Health
DR. W. J. K. HARKNESS	- - -	Ontario Dept. of Lands and Forests
PROF. J. D. LEE	- - -	Civil Engineering, Queen's University
MR. H. S. MATTHEWS	- - -	Matthews-Wells Company Limited
PROF. R. R. McLAUGHLIN	- - -	Chemical Engineering, University of Toronto
MR. ALEX. D. McRAE	- - -	Imperial Oil Limited
MR. W. C. MILLER	- - -	City Engineer, St. Thomas
MR. A. E. PROCTOR	- - -	Brantford Produce Co. Limited
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation

### Meetings:

- April 6th, 1951, 39 Queen's Park, Toronto.
- June 27th, 1951, 39 Queen's Park, Toronto.
- November 30th, 1951, 39 Queen's Park, Toronto.
- January 18th, 1952, Queen's University, Kingston.

## MINES, MINERALS AND METALLURGY RESEARCH

### Main Committee:

MR. N. F. PARKINSON	- - -	Ontario Mining Association (Chairman)
MR. T. H. ADAIR	- - -	Atlas Steel Company
PROF. H. S. ARMSTRONG	- - -	Geology, McMaster University
PROF. O. A. CARSON	- - -	Metallurgy, Queen's University
DR. O. W. ELLIS	- - -	Ontario Research Foundation
DR. G. S. FARNHAM	- - -	International Nickel Company of Canada Limited
PROF. J. E. HAWLEY	- - -	Mineralogy, Queen's University
DR. G. S. HUME	- - -	Dominion Dept. of Mines and Technical Surveys
PROF. G. B. LANGFORD	- - -	Geological Sciences, University of Toronto
MR. J. MacRAE	- - -	Dome Exploration Co.
PROF. L. M. PIDGEON	- - -	Metallurgical Engineering, University of Toronto
PROF. G. H. REAVELY	- - -	Geology, University of Western Ontario
MR. H. C. RICKABY	- - -	Ontario Dept. of Mines
MR. R. H. RIMMER	- - -	Aluminium Laboratories Ltd.
MR. W. A. ROLLIFF	- - -	Imperial Oil Limited
MR. W. SAMUEL	- - -	Steep Rock Iron Mines Ltd.
DR. C. R. WHITTEMORE	- - -	Deloro Smelting & Refining Co. Ltd.
DR. G. E. WILLEY	- - -	Algoma Steel Corporation, Ltd.
PROF. C. G. WILLIAMS	- - -	Toronto
PROF. J. T. WILSON	- - -	Physics, University of Toronto
MR. R. B. YOUNG	- - -	Ontario Hydro-Electric Power Commission

### Meetings:

- December 7th, 1951, Ontario Research Foundation, Toronto.

#### Executive:

MR. N. F. PARKINSON	- -	Ontario Mining Association
(Chairman)		
DR. O. W. ELLIS	- - -	Ontario Research Foundation
PROF. G. B. LANGFORD	- -	Geological Sciences, University of Toronto
MR. H. C. RICKABY	- - -	Ontario Dept. of Mines
DR. C. R. WHITTEMORE	- -	Deloro Smelting & Refining Co. Ltd.
PROF. C. G. WILLIAMS	- -	Toronto
MR. R. B. YOUNG	- - -	Ontario Hydro-Electric Power Commission

#### Meetings:

April 23rd, 1951, 39 Queen's Park, Toronto.

November 6th, 1951, 39 Queen's Park, Toronto.

November 30th, 1951, 39 Queen's Park, Toronto.

April 4th, 1952, 39 Queen's Park, Toronto.

#### WIRE ROPE:

DR. O. W. ELLIS	- - -	Ontario Research Foundation
(Chairman)		
MR. I. A. USHER	- - -	Ontario Research Foundation
(Secretary)		
MR. N. B. BROWN	- - -	Dominion Dept. of Mines and Technical Surveys
MR. W. E. BROWN	- - -	B. Greening Wire Co. Ltd.
MR. R. E. DYE	- - -	Dome Mines Ltd.
MR. A. C. HALFERDAHL	- -	National Research Council
MR. R. L. HEALY	- - -	Wright-Hargreaves Mines Ltd.
MR. J. G. MORROW	- - -	Steel Company of Canada Ltd.
MR. R. D. PARKER	- - -	International Nickel Company of Canada Limited
MR. N. F. PARKINSON	- -	Ontario Mining Association
MR. R. S. SEGSWORTH	- -	General Engineering Co. (Canada) Ltd.
MR. D. G. SINCLAIR	- - -	Ontario Dept. of Mines
MR. L. W. SPOULE	- - -	Imperial Oil Limited
MR. D. G. WATT	- - -	Ontario Hydro-Electric Power Commission

#### Meetings:

October 24th, 1951, Ontario Research Foundation, Toronto.

June 6th, 1952, Ontario Research Foundation, Toronto.

#### FERROUS METALLURGY:

DR. O. W. ELLIS	- - -	Ontario Research Foundation
(Chairman)		
MR. P. E. CAVANAGH	- -	Ontario Research Foundation
(Secretary)		
MR. T. W. HARDY	- - -	Climax Molybdenum Company
MR. F. A. LOOSLEY	- - -	Dominion Foundries and Steel Ltd.
MR. N. F. PARKINSON	- -	Ontario Mining Association
(ex officio)		
MR. W. SAMUEL	- - -	Steep Rock Iron Mines Ltd.
MR. R. J. TRAILL	- - -	Dominion Dept. of Mines and Technical Surveys
MR. D. G. WATT	- - -	Ontario Hydro-Electric Power Commission
DR. G. E. WILLEY	- - -	Algoma Steel Corporation, Ltd.
MR. R. B. YOUNG	- - -	Ontario Hydro-Electric Power Commission
MR. T. H. ADAIR	- - -	Atlas Steel Company
(Co-operating)		
PROF. G. LETENDRE	- -	Laval University
(Co-operating)		



MR. J. S. McMAHAN	-	-	Steel Co. of Canada, Ltd.
(Co-operating)			
DR. NORMAN PARLES	-	-	Dominion Steel and Coal Co.
(Co-operating)			

#### Meetings:

June 25th, 1951, Ontario Research Foundation, Toronto.  
 April 4th, 1952, Pilot Plant, Oakville.

#### GEOLOGY:

PROF. G. B. LANGFORD	-	-	Geological Sciences, University of Toronto
(Chairman)			
MR. J. O. GORMAN	-	-	Ontario Hydro-Electric Power Commission
PROF. J. E. HAWLEY	-	-	Mineralogy, Queen's University
DR. D. F. HEWITT	-	-	Ontario Dept. of Mines
MR. M. E. HURST	-	-	Ontario Dept. of Mines
DR. H. S. SCOTT	-	-	Physics, McMaster University

#### NON-FERROUS METALLURGY:

DR. C. R. WHITTEMORE	-	-	Deloro Smelting & Refining Co. Ltd.
(Chairman)			
DR. O. W. ELLIS	-	-	Ontario Research Foundation
DR. G. S. FARNHAM	-	-	International Nickel Company of Canada Limited
MR. W. M. GOODWIN	-	-	Dominion Dept. of Mines and Technical Surveys
MR. L. J. LICHTY	-	-	Ventures, Ltd.
DR. L. M. PIDGEON	-	-	Metallurgical Engineering, University of Toronto
MR. M. J. TAMPLIN	-	-	Falconbridge Nickel Mines

#### SOILS RESEARCH

##### Main Committee:

MR. L. J. CHAPMAN	-	-	Ontario Research Foundation
(Secretary)			
PROF. E. H. GARRARD	-	-	Bacteriology, Ontario Agricultural College
MR. G. ANGUS HILLS	-	-	Ontario Dept. of Lands and Forests
MR. R. N. JOHNSTON	-	-	Ontario Dept. of Lands and Forests
DR. A. LEAHEY	-	-	Dominion Dept. of Agriculture
PROF. F. F. MORWICK	-	-	Soils, Ontario Agricultural College
DR. E. F. PALMER	-	-	Ontario Dept. of Agriculture
MR. F. L. PECKOVER	-	-	National Research Council
PROF. D. F. PUTNAM	-	-	Geography, University of Toronto
MR. A. H. RICHARDSON	-	-	Ontario Dept. of Planning and Development
PROF. G. N. RUHNKE	-	-	Ontario Dept. of Agriculture
PROF. W. L. SAGAR	-	-	Civil Engineering, University of Toronto
DEAN J. W. B. SISAM	-	-	Forestry, University of Toronto
DR. H. B. SPEAKMAN	-	-	Ontario Research Foundation
MR. J. WALTER	-	-	Ontario Dept. of Highways



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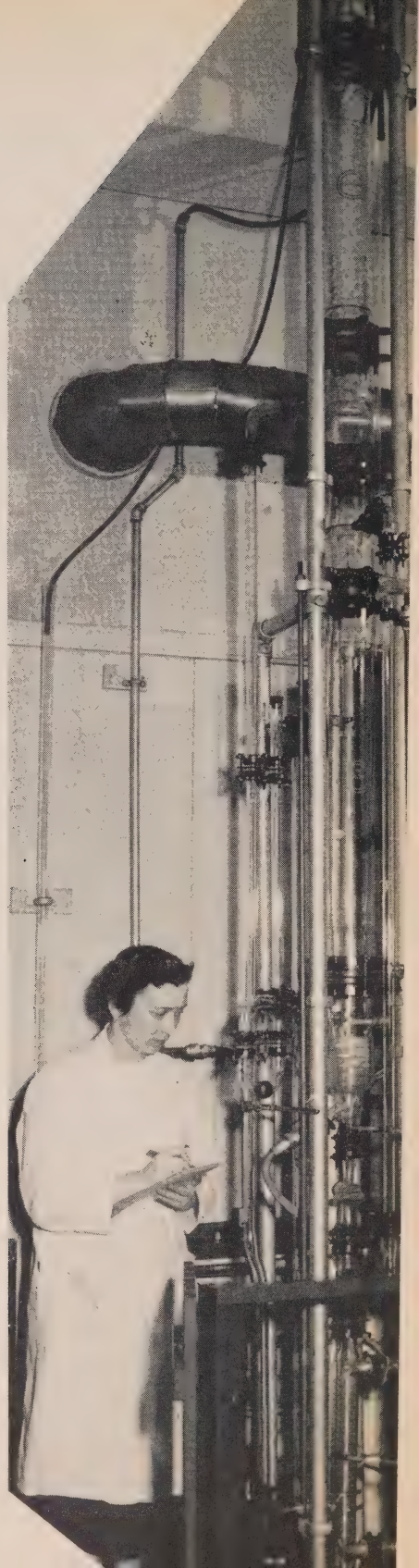
UNIVERSITY OF TORONTO

## RESEARCH COUNCIL OF ONTARIO

### Annual Report - 1953

Solvent extractor, Ontario Research Foundation, used in the preparation of a tanning agent from waste sulphite liquor, by-product of pulp mills.

Photo: Ontario Department  
of Lands and Forests







# RESEARCH COUNCIL OF ONTARIO

## *Fifth Annual Report*

1952 - 1953



ONTARIO

TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON

PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY

Research Council of Ontario,  
39 Queen's Park Cres. E.,  
Toronto 5, Ontario.

July 16, 1953.

The Honourable W. K. Warrender, Q.C.,  
Minister of Planning and Development.

Sir:

Attached hereto is the report of the Research Council of Ontario for the fiscal year April 1, 1952, to March 31, 1953. The Director's Report briefly outlines the activities of the Council. The reports of the eight advisory committees are also included, together with a statement of expenditures of the Council for the year and a list of scholarship awards.

During 1952 the Council made a very extensive and careful study of research activities in various fields throughout the Province. A report on this subject has been submitted to you for presentation to the Cabinet. It is hoped that as a result of this study better use can be made of present research facilities serving the Province, and a more balanced research program developed.

In general, research projects of necessity require many years' work before the full significance of the undertaking can be appreciated. The research work under the guidance of the advisory committees is therefore becoming more and more significant. The value of such work should continue to increase throughout the coming years.

Respectfully submitted,

R. K. Stratford,  
President.

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# RESEARCH COUNCIL OF ONTARIO

R. K. STRATFORD, B.S.A., M.Sc., D.Sc., LL.D., F.C.I.C. (President)	Scientific Adviser, Imperial Oil Limited, Sarnia.
G. E. HALL, B.S.A., M.A., M.D., Ph.D., F.R.S.C. (Vice-President)	President, University of Western Ontario, London.
G. P. GILMOUR, D.D., D.C.L.	President, McMaster University, Hamilton.
E. HOLT GURNEY, LL.D.	Chairman of the Board, Gurney Products Limited, Toronto.
HUGH LAWSON, B.Sc.	Vice-President, York Knitting Mills, Limited, Toronto.
W. A. MACKINTOSH, C.M.G., M.A., Ph.D., LL.D., F.R.S.C.	Principal, Queen's University, Kingston.
W. E. PHILLIPS, C.B.E., D.S.O., M.C., LL.D.	50 St. Clair Ave. W., Toronto.
G. N. RUHNKE, B.S.A., M.S.A., F.C.I.C., F.A.I.C.	Director of Research, Ontario Dept. of Agriculture, Guelph.
SIDNEY E. SMITH, M.A., LL.B., D.C.L., LL.D. F.R.S.C.	President, University of Toronto, To- ronto.
H. B. SPEAKMAN, M.Sc., D.Sc., LL.D.	Director, Ontario Research Foundation, Toronto.
K. F. TUPPER, O.B.E., B.A.Sc., S.M.	Dean, Faculty of Applied Science and Engineering, University of Toronto, Toronto.
H. M. TURNER, B.S., M.S.	President, Canadian General Electric Co. Limited, Toronto.
<b>Director:</b>	
J. O. WILHELM, O.B.E., B.Sc., M.A.	Research Council of Ontario, Toronto.

## Meetings:

June 22-23, 1952, Glen Gordon Manor, Blenheim.  
Nov. 21-23, 1952, General Brock Hotel, Niagara Falls.  
Mar. 12-13, 1953, Guild Inn, Scarboro.

## Executive:

DR. R. K. STRATFORD (President)	DR. G. E. HALL (Vice-President)
Dr. E. HOLT GURNEY	MR. HUGH LAWSON
DEAN K. F. TUPPER	

## Meetings:

Apr. 30, 1952, 39 Queen's Park, Toronto.  
June 21, 1952, William Pitt Hotel, Chatham.  
Sept. 8, 1952, 39 Queen's Park, Toronto.  
Nov. 21-23, 1952, General Brock Hotel, Niagara Falls.  
Jan. 26, 1953, 39 Queen's Park, Toronto.  
Mar. 12, 1953, Guild Inn, Scarboro.

## Scholarship Committee:

DR. R. K. STRATFORD (Chairman)	DR. G. E. HALL
DR. G. P. GILMOUR	MR. HUGH LAWSON
DR. W. A. MACKINTOSH	PROF. G. N. RUHNKE
DR. SIDNEY E. SMITH	DEAN K. F. TUPPER
DR. H. B. SPEAKMAN	J. O. WILHELM (ex officio)

## Meetings:

April 30, 1952, 39 Queen's Park, Toronto.  
March 12, 1953, Guild Inn, Scarboro.



## DIRECTOR'S REPORT

Nineteen fifty-three marks the fifth year of the Research Council of Ontario and the eighth year since the end of World War II, when the Government of Ontario gave renewed attention to peace-time problems of industries and the management of natural resources. In August of 1945 the Ontario Research Commission began an extensive survey of research needs and activities in Ontario. In February of 1948 the Commission's final report was made to the Government, recommending the establishment of the Research Council of Ontario and proposing its terms of reference.

The period of five years during which the Research Council has operated is sufficient to indicate trends and achievements, some of which are most encouraging. It is of interest, therefore, to consider current activities of the Council in the light of its chief functions as recommended by the Ontario Research Commission.

A major responsibility of the Research Council is to correlate government research effort in the Province in order to ensure a balance with the needs of the various natural resources. It was intended from the beginning that assistance in each important field of research should be given by an advisory committee representing all the active interests and agencies; these committees to serve as a medium for discussion and for closer co-operation between already well-established research agencies. In addition, the advisory committees would be responsible for initiating further research needed in their respective fields. This might be indicated by problems requiring immediate solution, by future long-term needs, or suggested by research developments elsewhere.

Eight advisory committees are now functioning in various areas of the natural and physical sciences. These are in agriculture, forestry, fisheries and wildlife, highways, industrial research, industrial waste, mines and metallurgy, and aerial surveys. The advisory committees have been very effective in bringing together industrial, governmental, and university research people to examine problems and supervise programs of research. The current cost of research projects supported on the recommendation of the advisory committees is \$463,000. The reviews of the eight advisory committee chairmen, included in this report, indicate the range and nature of the work of the committees.

A number of developments in the work of the advisory committees should be noted here because they exemplify a tendency toward closer co-operation in research, not only between government agencies but also between government and industry. The Ontario Research Commission, aware of the remarkable growth of industrial research associations in Great Britain, recommended that co-operative industrial research be encouraged in Ontario, and to this end a provision of the Research Council of Ontario Act permits financial support by the Province in any approved project of

research which two or more companies conduct jointly. Two group research projects have been initiated this year. One is a forest research project at Heron Bay, Ontario, where The Ontario Paper Company Ltd. and the Abitibi Power and Paper Company Ltd. are co-operating in a silvicultural program with the provincial government. Other agencies that are interested include the Pulp and Paper Research Institute of Canada, the Ontario Department of Lands and Forests, the federal Departments of Agriculture and Resources and Development, and the Faculty of Forestry of the University of Toronto. The way in which this project developed and the bearing which it may have on further developments is outlined in the report of the Committee on Forestry Research. A second project concerns the investigation of air and water pollution in the Sarnia area. Here five companies are co-operating with the Research Council in a study which is under the direction of the Council's Committee on Industrial Waste, with technical supervision provided by the Air Pollution Laboratory of the Ontario Research Foundation. Other group research projects have been continued while others are under discussion.\*

In several areas, therefore, beginnings have been made in group research which may well establish a pattern for greatly expanded co-operative effort between the Province and industry.

Another field of joint effort, mainly inter-governmental in character, is developing in the work of the Fisheries and Wildlife Committee, where a combined program of fisheries research is being worked out for the Great Lakes by the federal Fisheries Department, the Department of Lands and Forests of Ontario, and the Research Council of Ontario. Other advisory committees are seeking more concerted action on specific problems by various government research agencies, federal or provincial. Instances are noted in the committee reports.

The Ontario Research Commission recognized from the outset the very real problem which lies with small industries. Quoting from the Commission's final report (p. 20), it was viewed with some concern that "many small industries are unaware of the import of scientific research; to many the idea has never occurred that science has any practical bearing upon their businesses; many firms are so small that they are unable either to set up laboratory research facilities of their own or to support fellowships in a public research institute. Such firms are without defence against the penalties that result from obsolete processes and products. It is as much the duty of government to aid in providing the needed defence for small industries and their dependent communities as it is in other fields. However, the method of providing aid of this type is different, difficult, and slow, as it was at one time in Great Britain."

With the aid of the Canadian Manufacturers' Association, the Trade and Industry Branch of the Department of Planning and Development, and

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\* See Appendix IV, page 54, Group Research.

the Ontario Research Foundation, a research advisory service for small industries was set up in 1947. The agency, known as Industrial Research Services, was instituted as an extension department of the Ontario Research Foundation to be assisted by public funds as recommended by the Advisory Committee on Industrial Research of the Research Council. Industrial Research Services has developed a confidence and working knowledge in research among small establishments throughout Ontario which is increasing year by year. The importance of this aid is accented by the position which the smaller industries hold in our social and productive life. Firms employing less than 50 people in Ontario represent about 94% of the number of all manufacturing establishments and produce nearly 30% of all manufactured products.

By an arrangement made last year with the National Research Council, Industrial Research Services has been expanded to take over the Ontario organization of the Technical Information Services of the federal agency. This tightens up the liaison with the excellent library facilities in Ottawa and will obviate undesirable duplication in the federal and provincial services.

In other respects as well the association between the Research Council and the Ontario Research Foundation is mainly in the industrial field. The Foundation laboratories are the core for many of the applied research projects supported by the Council, whether in problems related to wood chemistry, the use of agricultural by-products, or metallurgy. Members of the Foundation's staff act on nearly all of the Council's advisory committees.

Mere volume in research is not a substitute for quality. Competent research personnel are the key to real achievement both in applied research and in the fundamental studies which lay the foundation for future advances. The Ontario Research Commission initiated a system of scholarships to assist outstanding science students in Ontario universities, and it has been the privilege of the scholarship committee of the Research Council to continue the annual awards. Since the inception of the plan 282 students have been assisted in post-graduate research training. Of the 166 who have completed their training, nearly all to the M.A. or Ph.D. degrees, 133 are employed in scientific work in Canada. Of these 62 are in federal or provincial government departments, 40 are employed in Canadian industry, and 31 are members of the staffs of Canadian universities. Thirty-three, or 20%, have taken employment outside of Canada, at least temporarily. A further analysis is included in the remarks of the chairman of the Fisheries and Wildlife Committee. This year the scholarship committee met twice, in March and in April, to consider 142 applications for next year. Sixty-seven awards were made.

The Research Council met three times during the past year. On June 22nd and 23rd a meeting in southwestern Ontario reviewed the work of the University of Western Ontario at Erieau and Rondeau Park, and Council members visited the Agricultural Experiment Station at Ridgetown. An autumn meeting was held on November 21st to 23rd at Niagara Falls, Ontario, where the budget and the operations of the Council were discussed

in some detail with the Minister of Planning and Development. The last meeting was held in Toronto in March, when the reports of the various committee chairmen were received and considered.

The President and the Director have met several times with the chairmen of the advisory committees. Terms of references were reviewed and committee programs discussed. Some emphasis was placed also on establishing concise relationships between the work of the various committees.

A good deal of preliminary work aimed at estimating research expenditures in our government departments and universities has been conducted since 1945. This has involved assistance from administrative officers in our universities and provincial research agencies, as well as authorities in Ottawa since the volume of work performed by our various federal research agencies is considerable and its full utilization by the Province a matter of great importance. During the past year recent statistics on expenditures for research affecting Ontario have been compiled and comparisons made, on the basis of population and value of production, with expenditures in other industrialized countries. These figures are included in a report and recommendations which the President of the Research Council has prepared for early presentation to the Cabinet.



# ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH

Chairman: Prof. G. N. Ruhnke

The main Committee held two meetings during the past year to consider a more effective organization for surveying and appraising agricultural research in the Province and for advising on the development of a well-balanced research program for the future. It was planned to organize five sub-committees to assist in the special areas of economics, soils, biology, engineering, and food processing. Two of these sub-committees—on agricultural economics and on soils—are already formed and operating. Cooperation in these committees will be given by federal and Ontario government departments and by an active group of practising farmers.

In the engrossing task of working with nature in the production of crops and animals, agricultural science has assumed an ever-increasing importance over the past fifty years. A new world of knowledge has been opened concerning the nature of soils, requirements of plants, control of virus and fungus diseases, combatting of insect plagues, breeding and care of stock. Along with such scientific developments as new and better strains of plants, trees, animals and poultry, a tremendous increase has been made in the acre production of cereal, fruit, and forage crops.

In Ontario most of the research in agricultural sciences has been done by the Ontario Department of Agriculture and by the Experimental Farms Service and the Science Service of the federal Department of Agriculture. Federal and provincial research agencies have always enjoyed harmonious relations. It is essential that a free transfer of information among these groups be maintained and, if possible, further encouraged and facilitated.

The Ontario Department of Agriculture has for many years done extensive research in the Ontario Agricultural College and the Ontario Veterinary College at Guelph, and more recently in horticulture at the Horticultural Experiment Station at Vineland. The new Economics Branch of the Department conducts important studies in agricultural production, current farming practices, and costs of all types of farming operations in Ontario. The Department has done much through its publications and extension programs to assist the enterprising farmers of the Province.

From the scientific point of view agricultural research is much more complex than it used to be, because the problems left to solve are more difficult and require the combined efforts of groups of research specialists from various fields. There is a growing realization of the need for integrating certain major problems of agriculture with related problems in forestry, water and soil conservation, storage and transportation, and industrial practices in the utilization of farm products.

For example, the Advisory Committee on Agricultural Research and the Advisory Committee on Forestry Research are studying a plan for a map which will define the best soils and sites for both farm crops and forest trees in Ontario. This will be of joint value in the necessary program of restoring some of the great natural forest areas of Southern Ontario, providing soil and water conservation for farm lands, and defining suitable uses for marginal lands which are presently unproductive.

The Advisory Committee also plans to co-operate with foresters in assisting farmers in the proper management of their own woodlots. Good silvicultural practices on the thousands of acres of private bushlands in the Province can be of economic advantage to the farmer, as well as of great future importance to our wood productivity and indirectly act as a valuable natural protection for wildlife.

Other problems in agriculture may need the contributions of various scientists, other than agriculturists. The possible use of aircraft in agricultural surveys is under consideration in conjunction with physicists of the Aerial Surveys Committee of the Research Council. Studies in the storage, shipment, and processing of feeds, fruits and vegetables, and in the economics of farm machinery are projects for the engineer and the economist. Making use of waste materials which attends the processing of farm products is not only a problem for the food chemist; it also demands pilot plant work and studies in costs and marketing.

### **Agricultural Economics**

The Sub-Committee on Agricultural Economics has held three meetings. Preliminary surveys were made of some of the urgent problems for which the support of the Research Council is recommended.

The first problem concerns the economics of transportation, storage, bulk supply, and distribution of western feed grain in Ontario. The production of live stock is intimately tied up with feed grain supplies, and the Ontario Federation of Agriculture considers this a top priority project for investigation.

A second problem is that of forage crop production, with special attention to the economics of forage harvesting machinery. To date there have been no studies of this kind undertaken in Ontario, but the trend toward further mechanization to replace labour, on the one hand, and declining agricultural prices, on the other, has created an acute need for a study of forage crop harvesting.

The Federation of Agriculture has also urged an investigation into the marketing of fruit, including processing and distribution, with a view to increasing the demand and extending the producer's markets. Eight other problems in farm economics which are of common concern to Ontario and the Canadian Department of Agriculture are under review.

## Soils

The Sub-Committee on Soils held three meetings. Work done to date on soils was reviewed, together with current projects in the Departments of Agriculture, Lands and Forests, Planning and Development, and Highways, and the Ontario Research Foundation. The problem of soil classification for agriculture and for forestry was considered, looking to the possibility of pooling survey information from several sources to make a soils map of Ontario. There is a need for such a map for educational and extension purposes and for planning future agricultural expansion in the Province. Some of the current problems in soil microbiology which are being studied at the Ontario Agricultural College were also reviewed.

## Continuing Research

In addition to the projects mentioned above the Research Council is continuing its support of agricultural research concerned with plant diseases, the freezing of food, fungi and viruses affecting potatoes and tomatoes, food chemistry, and mineral deficiencies in horticultural crops. These projects are centred in the Ontario Agricultural College and several of the universities. At the Ontario Research Foundation valuable long-term work on the utilization of farm products and on physiography and climatology is receiving continued assistance from the Council.

## ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE RESEARCH

Chairman: Prof. J. R. Dymond

The primary industries based on the fisheries and wildlife resource of the Province differ in two respects from many other industries:

1. They consist of many relatively small-scale operations by fishermen, trappers, and tourist resort owners. In this respect the industry resembles agriculture rather than forestry. There are no large wealthy organizations based on the exploitation of fisheries and wildlife.
2. Most land and water areas where fish and wildlife are produced are publicly owned and controlled, so that the management of the resource is largely in the hands of the Government.

The greatest need in the application of science to improvement in the management of the fisheries and wildlife resources of the Province is the employment of more trained biologists by the Department of Lands and Forests, both in the Research Division and in the division responsible for administration. For a variety of reasons universities are not equipped, nor is it their proper sphere, to carry out applied research in these fields. That responsibility belongs to government laboratories. The funds now being provided are quite inadequate in view of the number and complexity of the problems involved.

Another critical need in the management of fisheries and wildlife is to provide proper information to fishermen, sportsmen, and others concerned in the exploitation of these resources. This need may be illustrated by reference to the function of fish hatcheries. Research has shown that hatcheries have limited value in maintaining or increasing the production of fish in natural waters. Dr. W. J. K. Harkness in an official news release of the Department of Lands and Forests has referred to the "extreme and unwarranted confidence placed in the value of the fish hatchery products" and stated that "after a good many years of active hatchery work it became evident that hatcheries were not supporting either the game or commercial fisheries, as had been anticipated".

Advantage cannot be taken of this knowledge because the public still demands more use of hatcheries and of the hatchery product in fisheries management. Many thousands of dollars are being wasted because facts demonstrated by research have not yet been appreciated by the interested public. Much of the money now spent on hatcheries could be put to much better use in other directions. What is true in the matter of hatcheries is true in other aspects of fisheries and wildlife management. Until the public is brought to understand some of the important facts bearing on the production of fish and wildlife so that they quit insisting on wrong technique



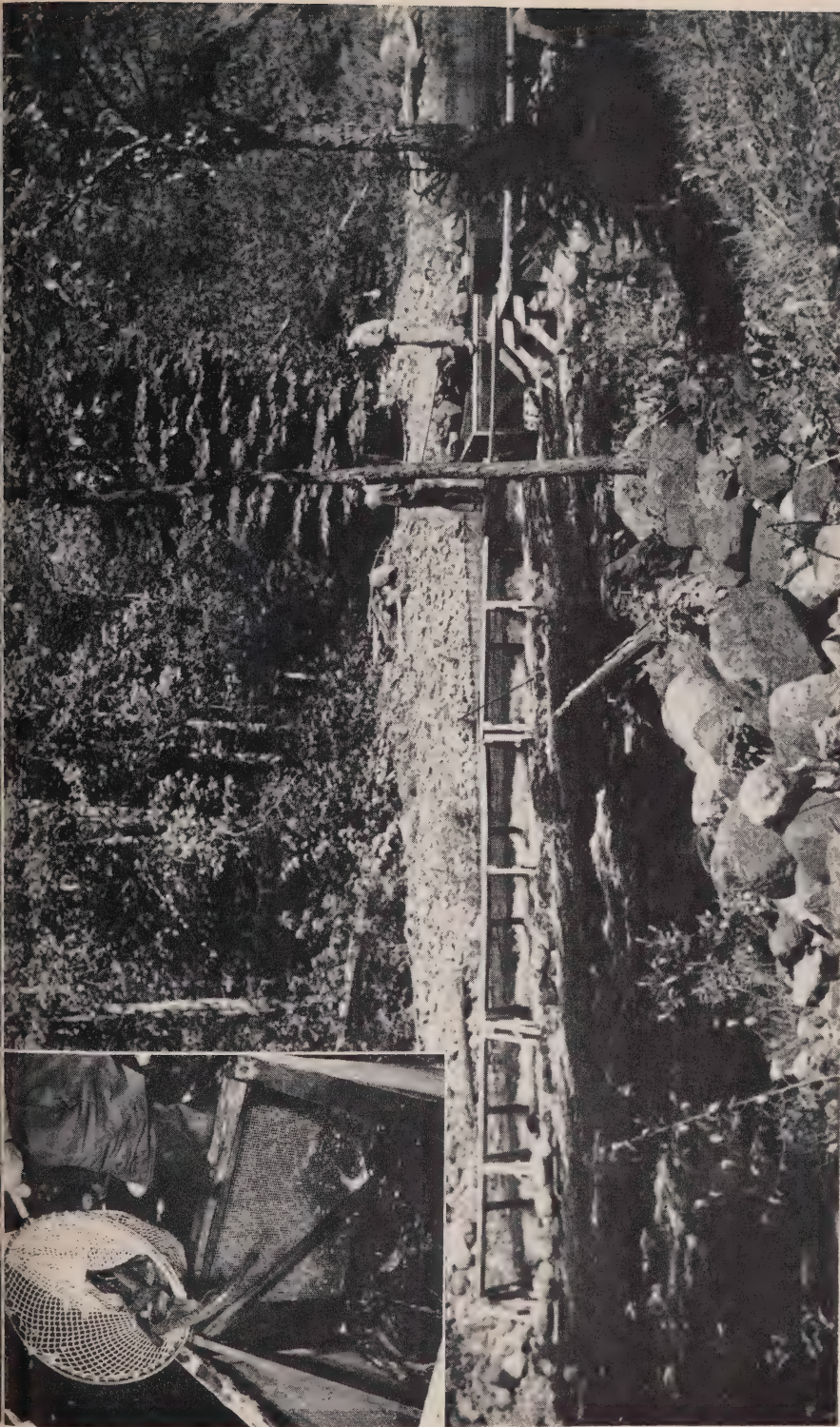


Photo: Ontario Department of Lands and Forests

Sea lampreys being trapped in their spring breeding waters by officials of the Ontario Lands and Forests Department.

Inset: lampreys removed from circulation.

The control of the sea lamprey is one of many problems affecting Great Lakes fisheries which research must help to solve.

and begin to demand better ones, the results of much research will be unused.

## Publication of Research Results

There is no agreement as to how much of the responsibility for public education in the results of research belongs to the research scientist. However there can be no doubt that he has the responsibility of organizing and interpreting the results of his research for the information of those who need it either in administration or in education. This involves publication.

Scientists whose research may have an application in the management of fisheries and wildlife have not organized, interpreted and published as much of the results of their research as should have been done. One reason for this is the pressure of other duties. It is only relatively senior scientists who can properly organize, interpret and publish the results of research or supervise publication by junior research personnel, including graduate students. Senior university scientists whose work is in fields related to fisheries and wildlife cannot possibly meet all the obligations falling on them to-day. These include lecturing and supervision of undergraduate laboratories, supervision of the work of graduate students, acting as consultants to government departments, and serving on committees having to do with research. Publication and supervision of publication by others is the least pressing of their obligations and the one most easily postponed. Delay in publication and the lack of interpretation of the results of research for application are interfering with the full realization of the results of research in management. The lack of an adequate number of senior university personnel to carry the load of training students, interpreting the results of research, and serving governments is a serious bottleneck in the application of science to fisheries and wildlife.

The training and employment of a sufficient number of qualified men in research, education and administration is the most effective way of bringing about a better utilization of our fisheries and wildlife resources. The Research Council of Ontario, through its support of research, is assisting in the training of personnel who are finding employment in all phases of the effort to improve fisheries and wildlife management. At every level much more must be done if the need is to be adequately met.

## Wildlife Research

Another problem to which the Fisheries and Wildlife Committee has given a good deal of attention is the disparity between the research effort devoted to wildlife as compared with fisheries. This has also been discussed by the National Research Council. On October 6th, 1952, the matter was considered by a special committee representing the National Research Council and the Research Council of Ontario. Funds allocated by the two re-



search councils for the support of aquatic research have been twice those for research on terrestrial animals. It was found that this situation has a historical basis and is true for other countries as well as for Canada. Fisheries research in Canada was begun over fifty years ago, whereas wildlife research is a relatively recent development. The situation cannot be corrected quickly because of the time required to develop research personnel capable of directing research programs; but the two councils are co-operating in any way they can to encourage the development of more research on the biology of terrestrial animals, including game and fur-bearing species.

### **Great Lakes Fisheries**

Problems presented by the fisheries of the Great Lakes received considerable attention during the year. These fisheries present many problems, some of which have become critical in recent years. One of these is the invasion of the upper lakes by the sea lamprey. Although the decline of the commercial catch of lake trout in Lake Huron from a million and a half pounds a year for the period 1921 to 1940 to an average of 12,000 pounds for 1946 to 1950 may not be due entirely to the lamprey, there is evidence that its attacks have been an important factor. The introduction and spread of non-native species such as the smelt and the alewife are believed to have interfered with the production of some of the more valuable native fish. Pollution, including sediments washed from agricultural lands, especially around Lake Erie, must adversely affect conditions necessary for the success of a number of species. Fluctuations from abundance to scarcity, which characterize some commercial species, pose serious economic problems for the fishermen.

Research problems presented by Great Lakes Fisheries are many and complex because of the number of species involved and the variety of conditions presented by the different lakes. Management is complicated by the fact that five states and the Province of Ontario border the Great Lakes apart from Lake Michigan. As a culmination of numerous discussions by various committees and other groups concerned with Great Lakes fisheries, a general discussion of the subject under the auspices of the Fisheries and Wildlife Committee was held on November 6th and 7th, 1952. One of the recommendations arising from these meetings was that a biologist be appointed to co-operate with the fishermen in the study of their problems and in the application of the results of research in the management of the fisheries. That appointment has now been made. Discussions in which the Research Council is participating are now taking place between federal and provincial authorities for the initiation and co-ordination of further Great Lakes research.

### **Research Assistance**

Through the Advisory Committee on Fisheries and Wildlife the Research Council of Ontario supports research mainly in the universities and the Ontario Research Foundation.

The function of universities in research is twofold: the production of the researchers who will be employed by other research agencies, and the carrying out of fundamental research. During the past six years 115 students have been employed on biological research projects supported by grants under the auspices of the Committee on Fisheries and Wildlife. Of these 10 have completed graduate training and received Ph.D. degrees, 28 have received M.A. degrees while 36 are still undergoing graduate training, and 14 are still undergraduates. The 38 students who have completed training are now permanently employed —9 in universities, 6 in the federal Department of Agriculture, 5 in the Ontario Department of Lands and Forests, 4 in the Fisheries Research Board of Canada, 2 in the Defence Research Board, 1 each in the Ontario Research Foundation, Royal Ontario Museum of Zoology, and Canadian Wildlife Service, and 9 in other miscellaneous organizations. Ontario institutions employ 17, the federal government 13, other provinces 2; 5 are in the United States, and 1 in Africa. Twenty-seven of the 38 are employed in other than fisheries and wildlife work.

From these students eighty-four reports on research projects supported by Research Council of Ontario grants have been presented at technical sessions held under the auspices of the Advisory Committee on Fisheries and Wildlife, and 45 papers have been published. Although additions to fundamental knowledge of value in the management of fisheries and wildlife have resulted from the researches sponsored by this Committee, by far the most valuable contribution resulting from the expenditure of these research funds is in the production of research scientists, qualified to do research in a wide variety of biological fields including those related to agriculture, forestry, health, and defence, as well as to fisheries and wildlife.

At the universities, as well as at the Royal Ontario Museum, the Research Council of Ontario is supporting studies on plants which provide food and cover for wildlife; on the fertilization of water and the productivity of water as influenced by light; on the mineral content of lake-bottom soils; on the growth of plankton as essential food for small fish; on methods of predicting fish populations; and on various problems related to wild animals; their disease epidemics, migrations, and populations. In all this work there is co-operation between the provincial and federal agencies and with neighbouring research organizations in the United States who are working on similar problems.

## Parasitology

Studies in parasitology by the Ontario Research Foundation, although concerned chiefly with fish and wildlife, have implications for both man and his domestic animals. The hydatid disease now being studied affects, besides wild creatures, such domestic animals as sheep, cattle, hogs, and dogs. Blood protozoans affect domestic ducks as well as many wild birds. Work ha



been done on black flies, especially in their relation to the transmission of blood parasites.

The Foundation has important service functions, especially to the Department of Lands and Forests, in identifying parasites, answering inquiries, and preparing reports on special problems.

Disease caused by parasitic infection is a common cause of deaths among wild animals and is sometimes responsible for widespread epidemics among wildlife. Although the cure of disease among wild animals is not an immediate possibility, certain techniques of managing wildlife may reduce the probability of these disease plagues.



Photo: Queen's University Public Relations

Measuring radioactive substances, isotope laboratory, Department of Botany, Queen's University. The study: chemistry and physiology of Canadian woods.

# ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Dean J. W. B. Sisam

The work of the Advisory Committee on Forestry Research falls mainly into two fields, (1) forest production or growth, and (2) wood utilization.

## FOREST PRODUCTION

The money being spent on forestry research in Ontario is small in relation to the contribution which forestry and its related industries make to our economy. Nevertheless there are quite a number of agencies engaged in such research. These include the Forestry Branch of the federal Department of Resources and Development, the Forest Biology Division of the federal Department of Agriculture, the Research Division of the Ontario Department of Lands and Forests, the Pulp and Paper Research Institute, certain university departments, and various individual companies of the pulp and paper industry. It is apparent that unless these groups which are working in the same general field have their programs properly co-ordinated, there will almost certainly be considerable overlap and duplication of effort, resulting in a great waste of time and money. During the past few years a much closer association has developed between these groups with regard to research in Ontario. For example, as is pointed out in the annual research progress report of the Ontario Department of Lands and Forests for 1951, working arrangements have been arrived at between that Department and the federal Department of Agriculture, the University of Toronto, and the federal Forestry Branch.

This whole question of integration of effort in the field of forestry research has been under discussion by the Advisory Committee on Forestry since 1949. In this connection the Committee advocated the organization of forestry research in Ontario on a regional basis, having in mind that the Province of Ontario could be divided into five or six regions, within each of which the forest and other related conditions would be sufficiently similar to provide a good basis for investigation. It was further suggested that northwestern Ontario might be considered as one such region, within which a start could be made. Two developments that are being sponsored by the Research Council in this region are now under way:

### (a) Forest Research Committee, Northwestern Ontario

A committee representing the Provincial Government, the federal Department of Agriculture, the federal Forestry Branch, the Research Council of Ontario, and the pulp and paper industry was set up with the primary objective of co-ordinating research activities in northwestern Ontario. Its objective is "to encourage co-ordination of effort and foster co-operation in northwestern Ontario forestry research and to review general research needs in the area".

The means by which the Committee hopes to attain this objective are:

(1) By the institution of a clearing house in the form of a library for the collection and dissemination of information and data relevant to existing and proposed district research;

(2) By the collection and summarization annually, for subsequent circulation, information from all agencies pertinent to completed, active and proposed research projects;

(3) By the promotion of meetings between agencies planning action on similar projects or studies for discussion and standardization purposes.

A beginning has been made with this program. Library facilities suitable for research workers in this field are almost non-existent at the head of the Lakes, and at a meeting of the Committee in September, 1952, it was recommended that a local library be set up to serve in addition as an information centre on all work being done by the various organizations in the area. It was felt that if this was properly to serve its purpose, a full-time, paid librarian should be available, and the request has been made to the Research Council to support such an appointment in the beginning, in order to get forward with the program.

### **(b) Group Research Project**

Arising from the discussions on silvicultural research in northwestern Ontario, two pulp and paper companies have indicated an interest in co-operating on an investigation of the problem of establishing white spruce in certain types of forest in that region. This project has been organized by a committee which includes representatives of the companies interested, the Pulp and Paper Research Institute, the Research Council of Ontario, the federal Forestry Branch, and the Ontario Department of Lands and Forests. Work on this project will be under way early in the spring of 1953. This research is to be supported on a group basis, half the cost being paid by the two companies, and half by the Province.

As research programs develop and co-operation between the various interested agencies improve, it becomes necessary that the objectives of the various research programs be more accurately defined, and that a statement of long-term research policy be developed. This has, in fact, been done by the federal Forestry Branch during the past year, and is being considered by other organizations.

### **Regeneration Surveys**

The results of Professor R. C. Hosie's study of regeneration surveys, the report of which has recently been published, indicate that on a fairly large proportion of our better growing forest sites the regeneration of the more desirable commercial species after cutting is inadequate. It is concluded that if we are to have useful wood growing in sufficient quantities or



our better and more accessible sites, it will be necessary to carry out fairly extensive seeding or planting operations. Such procedures involve additional expenditures of money, which can only be justified if we ensure that they are undertaken in the most efficient manner, aiming at the maximum yield of wood of the desired kind and quality. If we in Ontario are to make progress toward improving future practices over those in the past, we must at the research level have two objectives in view: first, to ensure that adequate attention is given to each of the major fields involved, i.e. forest ecology, forest genetics, and the mechanics of nursery production and planting; and second, as the results of the various studies become available, whether through the federal forest service, provincial forest service, or industry, to see that these are incorporated in an expanding developmental program.

Among the projects currently supported by the Research Council of Ontario which have a bearing on this general problem are studies of:

- (1) The factors affecting the periodicity and quantity of seed production with a view to establishing a more regular and orderly source of seed of certain species;
- (2) Tree nutrition with particular reference to soil microbiology;
- (3) Antibiotics found under certain forest soil conditions and affecting tree growth;
- (4) Tree breeding and other aspects of forest genetics;
- (5) The mechanics of establishing tree plantations successfully.

These projects all have to do with obtaining basic information. For the development phase it has been suggested that a forester be appointed to apply the results of research and develop techniques incorporating these results, which can be used on a commercial scale. Such a man would, of course, have to work in close association with all those engaged in the basic research programs. It is suggested that if his appointment is supported by the Research Council of Ontario for the first year, it would be easier at the end of that period to determine on whose staff he would best fit permanently.

## WOOD UTILIZATION

There are two aspects of this problem: the physical utilization of wood, in connection with which the research is largely a responsibility of the Forest Products Laboratory in Ottawa; and chemical utilization, in which there is perhaps a greater industrial interest, with research programs being supported by the individual companies, both directly and through the Pulp and Paper Research Institute. A valuable program of research in chemical utilization is being carried on by the Ontario Research Foundation, and also at a number of universities in this Province, much of it with support from the Research Council of Ontario.

## Chemical Utilization

The Sub-Committee on Wood Chemistry has continued an active program during the past year. One of the functions of this Sub-Committee is to stimulate research in wood chemistry, and most of its attention in this connection has been directed to the teaching staffs at the universities. As this is in a sense a national rather than a provincial problem, it has been approached in co-operation with the fundamental research committee of the Pulp and Paper Association. A list of fundamental research problems in wood chemistry has been obtained from various pulp and paper companies, and these have been written up in some detail and published for distribution to the various universities and research laboratories across Canada.

A second function of the Sub-Committee is to review the projects in wood chemistry which are being carried out at the various universities through funds supplied by the Research Council of Ontario. At the present time McMaster, Queen's and Toronto Universities have wood chemistry projects under way.

This committee was also responsible for arranging a wood chemistry symposium at the Thirty-fifth Annual Conference of the Chemical Institute of Canada held in Montreal in June 1952. The purpose was to take wood chemistry outside of the pulp and paper industry and bring it to the attention of chemistry professors and research chemists working in other fields. Much interest was developed, and it was hoped to establish this symposium on an annual basis.

A further objective is to prepare reviews of various subjects in the field of wood chemistry and circulate these reports to the industry or publish them in the trade journals. An example of this is the bibliography on waste sulphite liquor, which is now being published on an annual basis.

Projects at the universities which will receive continued support by the Research Council in this field during 1953-54 include study of the synthesis of new organic compounds; the chemical processes that take place during the growth of plants; the conversion of pulp-mill waste materials into useful chemicals by oxidation.

The program of research in wood chemistry, carried on at the Ontario Research Foundation with support from the Research Council, has interesting commercial possibilities. Specific objectives at present are as follows:

**Carbohydrates**—The carbohydrate fraction of waste sulphite liquor constitutes about 20% of the total material. About 600,000 tons are produced annually by sulphite pulp mills in Canada, and is usually discarded along with the 2,400,000 tons of liquor and other byproducts in the waste sulphite liquor. Methods of isolating these carbohydrates in pure form have been developed and a study of their composition is being continued. This information will be invaluable in the development of commercial uses, such as the cheaper production of yeasts and alcohols.

**Tanning Agents**—A tanning agent, prepared from waste sulphite liquor, is now considered to be past the laboratory stage and ready for commercial trials. Equipment has been purchased and set up for producing adequate quantities of this product for production-scale tanning tests.

**Synthetic Boards**—Experiments have been undertaken to prepare a thermo-setting waterproof binder from waste sulphite liquor suitable for the manufacture of synthetic boards from sawdust and shavings. Commercial phenolic resins are now being used for this purpose but their high costs limit their application in this field. By reacting waste sulphite liquor with a waste product from an oil refinery a product has been prepared which is comparable in properties with urea-formaldehyde resins and presumably much cheaper.

**Dispersing Agents**—Dispersing agents have a wide variety of commercial uses, which include the prevention of scale deposits in boilers and the reduction of the viscosity of oil well drilling fluids. In the preparation of concrete the addition of a dispersing agent increases the fluidity of the mix and thus permits the use of a smaller ratio of water. This ultimately results in a stronger concrete. During the past few months attempts have been made to develop a dispersing agent from waste sulphite liquor which is suitable for these applications. Laboratory tests indicate that a product has been obtained which is equivalent to commercial dispersing agents now being imported into Canada. Arrangements have been made for the manufacture of this product and for carrying out field tests.

In conjunction with this practical work certain fundamental research on the chemistry of lignin is being carried out. Two such investigations are the chlorination and the phenolation of waste sulphite liquor. The results of this work will be published in the technical journals.

## Physical Utilization

The Advisory Committee has been interested in a number of aspects of the physical utilization of wood, particularly the reduction of wood waste and improvements in the uses and handling of this product. One project that has received support from the Research Council in past years and is now established on a co-operative basis with the Forest Products Laboratory in Ottawa, and it is hoped will also shortly include the Department of Lands and Forests, is an investigation into the efficiency of sawmill equipment and its operation.

The present position regarding this project is as follows: First, the research sawmill has been set up at the Forest Products Laboratory in Ottawa, and is now being used to carry on tests of various kinds. Second, two studies are being undertaken in the Department of Mechanical Engineering, University of Toronto, in association with the Forest Products Laboratory, one having to do with the distribution of stresses in hammered saw blades, and the other with the development of a log turner that might be adapted to a small portable or semi-portable mill. Third, plans are going forward to implement the recommendations of a report by J. W. Church, formerly of the University of Toronto, with respect to the development of a truly portable mill that can be so designed as to produce lumber of reasonably good quality.

The work on this program which is to be supported by the Research Council of Ontario during the coming year covers the mechanical engineering aspects of the sawmill and barking research, and is being conducted in the Department of Mechanical Engineering of the University of Toronto.

#### ECONOMICS OF FORESTRY

While a number of projects that have been and are being supported by the Research Council of Ontario have an economic significance in their application, up to the present time the Advisory Committee on Forestry has given little attention to the economics of forestry as such. An exception to this was the support given a graduate student in the Faculty of Forestry for a study of the taxation of privately owned woodlands under the municipal system of Southern Ontario.

Little work has been done in the field of forest economics either by economists or by foresters, perhaps because of the long-term nature of the problems involved. While a good deal of the work in this field might be classified simply as fact finding, there are nevertheless many problems that require thorough investigation. This is a field which urgently needs the attention of people interested in the future development of our forests, both at the provincial and national levels, and a sub-committee of the Advisory Committee on Forestry is being set up to look into the overall picture of forest economics in this Province. It is hoped that this committee will represent all groups, both governmental and industrial, that are associated with the future well-being of our forest resource.



## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Mr. A. K. Hay

Last year's report gave some indication of the greatly expanding field for highway research in the Province. The total expenditure by the Highways Department in 1952 was well over \$100 million and the corresponding expenditures on roads and streets by municipalities was at least an additional \$50 million. The figures for 1953 will probably be greater.

Highways research in the Province has been carried out almost exclusively by the Highways Department. In 1952 the Advisory Committee on Highways Research submitted a report giving an itemized list of projects which should be actively undertaken. These included research on designs for flexible pavements, on values for supporting subgrades and base courses, on designs for highway intersections, on frost action, and on such problems as traffic density and accident frequency as related to curvature, sight distance, gradients, surface conditions. The Department of Highways now has under construction north of Toronto a new building which will give much-needed space for activities of their research and testing division. When these facilities are available a greater volume of urgent research may be undertaken.

However, it does not appear that an adequate expansion of the existing program is possible without some further steps being taken in the matter of securing and retaining trained personnel. This is a problem which is particularly serious in the highways field. The attraction of higher salaries in other lines of endeavour makes it difficult to attract young engineers. There is also the very unfortunate situation that at the present time no appreciable amount of highways research is being undertaken by the universities. The average graduate in civil engineering courses has had no contact with highways work nor much opportunity to develop an interest in the problems of highways research. This is a matter which has been under discussion by the Committee at every meeting since its formation.

Last year a fresh approach to an integrated highway research framework for the Province was made. The possibility of setting up a new Highway research authority in which the Highway Department and either or both the University of Toronto and Queen's University would share is under investigation. There are several such joint projects in the United States which have produced excellent results. A particularly successful example is in the state of Indiana where the state Highway Department has operated a joint research project with Purdue University for a number of years. This type of activity not only produces answers to many of the problems met with by the Highway Department in the fields of design, construction, traffic and safety studies, but has a considerable influence on the engineering faculty of

the university, in that it demands a strengthening of its facilities for teaching of highway engineering at the undergraduate level.

During the year the Committee sent two observers to the test road project in Idaho, sponsored by the Western Association of State Highway Officials. This will be followed up in the coming year. In this as well as in other activities the Advisory Committee is co-operating with the Canadian Good Roads Association, who are making a real effort to promote highway research at the national level.

# ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: Mr. C. A. Pollock

The Advisory Committee on Industrial Research differs from the other advisory committees in one significant aspect: its field, which is extremely broad and varied, has always been essentially the responsibility of private enterprise. The Committee is concerned with encouraging among the industries of Ontario a greater incentive to employ research and the results of research which are now available, to make better use of scientifically trained personnel, and to share to their own advantage in the fuller utilization of natural resources. The healthy growth and stability of our industries will depend on an attitude of self-sufficiency and enterprise.

## The Industrial Research Services

In the past the activities of the Advisory Committee have been devoted mainly to providing support to the work of the Industrial Research Services Department of the Ontario Research Foundation. This Department was organized within the Foundation in 1947 for the purpose of making research facilities more easily available to small industries.\* It was a single-purpose effort to bridge the gap between an established fund of scientific knowledge and the thousands of small industrial establishments in the Province. Its mission has been to foster a realistic appreciation of research, and to promote confidence in the value of technical method, whether conceived as research or as testing and quality control.

As a practical demonstration of the utility of research assistance to small industries the progress of Industrial Research Services has been remarkable. Though cut back by a rapid turnover in field staff, due to salary competition from industry, the volume of work done for industry has increased steeply year by year. An even more encouraging trend in volume has been in favour of repeat calls and laboratory investigations. In 1952 laboratory work for clients showed an increase of 50% over 1951 in the number of jobs performed, and repeat jobs increased by about 10%. The increased load on the Foundation has been met in part by expansion of staff and facilities, particularly in the Department of Engineering and Metallurgy. The added financial problem which the growth of Industrial Research Services poses for the Foundation is of immediate concern to the Industrial Research Committee of the Research Council.

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\* In 1949, 89% of the industrial establishments in Canada had less than 50 employees (Canada Year Book, 1952-53, P. 640).

## Group Research and Publicity

The success of other activities of the Advisory Committee—in publicity and the development of group research—has been less tangible. These are recognized as long-term propositions. However, new situations which seem hopeful for co-operative research are being explored by Industrial Research Services. One project in group research with the American Electrolaters Society has been carried to the laboratory stage at the Ontario Research Foundation.

No further expenditure on publicity has been made during the past two years by the Advisory Committee. For the present the more urgent problem facing the Foundation is to provide staff and facilities to meet the present demand for service.

## Committee Objectives

Last year in a number of meetings of the Advisory Committee a re-examination was made of the Committee's functions and objectives within the meaning of the Research Council of Ontario Act. In this work the advice and suggestions of the President of the Research Council were most helpful.

The objectives of the Advisory Committee are necessarily broad: to promote a greater consciousness of the need for research by industry in Ontario; to promote the development and co-ordination of adequate research facilities within the Province. But the Committee plans to take more specific action than heretofore. Surveys will be made on the status of research in Ontario's industries and on the adequacy of research facilities available to them both within and outside their own laboratories. A study will be done on the extent to which industries may be helped by the Ontario Research Foundation through the Industrial Research Services Department; on factors affecting the organization of group research; on the extent of industry's acceptance of a responsibility for the maintenance of the Ontario Research Foundation. In this critical assessment of factors affecting industrial research in Ontario the combined experience of industry, the Canadian Manufacturers' Association, the Chambers of Commerce and Boards of Trade, and the Trade and Industry Branch of the Ontario Department of Planning and Development will be freely solicited.

## Sub-Committees

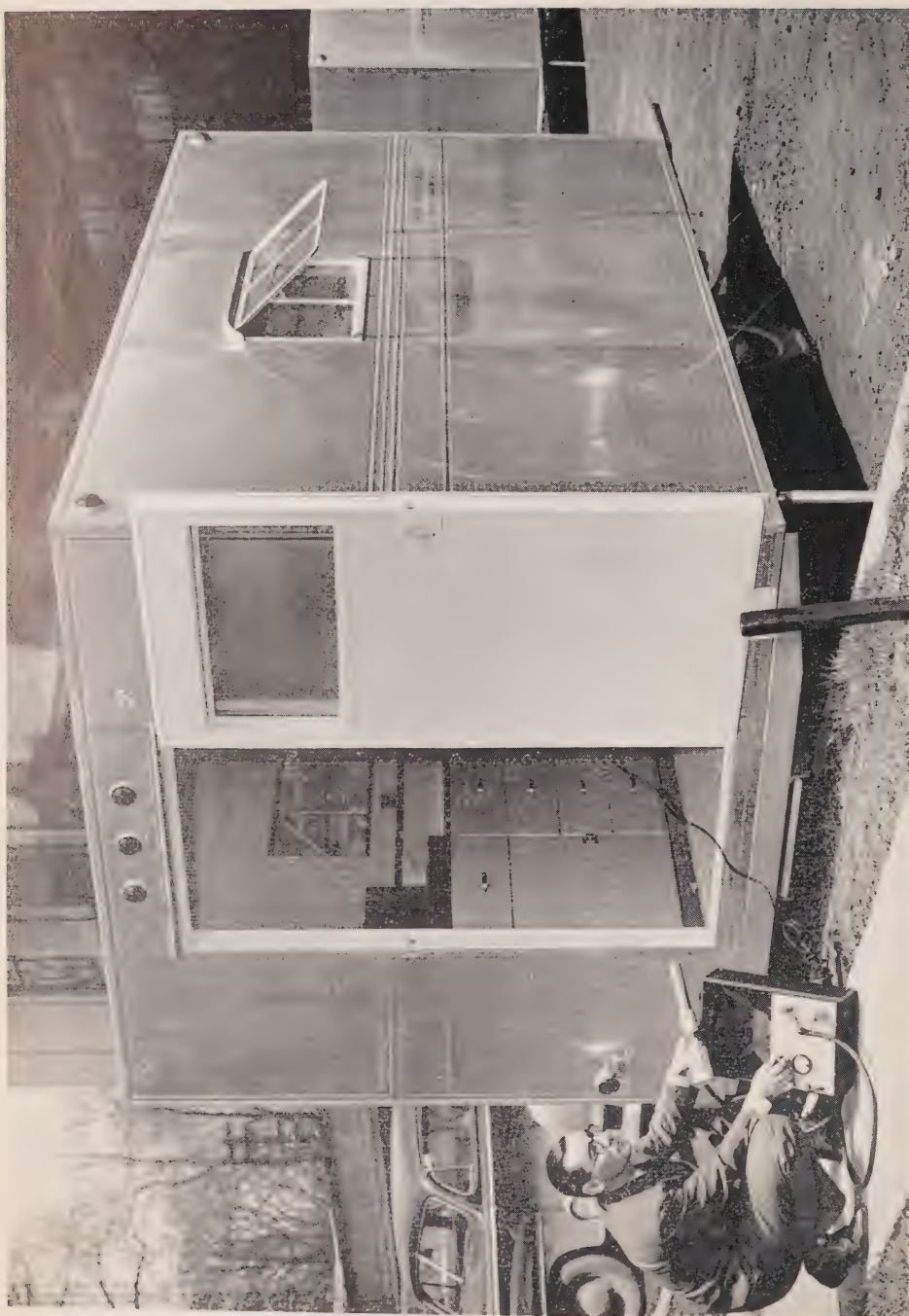
In order to develop a more concise pattern for action, specific responsibilities are to be divided among smaller groups or sub-committees. These include a steering sub-committee to cope with general integration of the Committee's work, to conduct inquiries into the status of research in Ontario, and to support scholarship in industrial research. Other sub-committees



will devote detailed attention to the needs of the Industrial Research Services, to the development of group research, and to general education and publicity.

Two recommendations have already been made to the Research Council for the support of action which the Advisory Committee wishes to take in the immediate future. One is for an increase in the yearly grant which the Province makes to Industrial Research Services which will permit the continuing employment and training of at least two research engineers. This would amount to a supplementary grant to the Industrial Research Services to cover part of its function in providing training in industrial research.

The other recommendation is that the Research Council consider the award of scholarships for studies dealing with the business and economic aspects of research activities in Ontario's industries.



Mobile sampling unit, Air Pollution Laboratory, Ontario Research Foundation, used for determining quantities of air pollution.

# ADVISORY COMMITTEE ON INDUSTRIAL WASTE

Chairman: Prof. A. C. Plewes

Chemical and other industries have come to regard the proper use of waste products as part of the whole industrial process, and much of the research done by these industries in recent years is concerned with the utilization of chemical by-products. The aspect of industrial waste which affects the public at large is known as pollution — harmful effects of which may result from chemical gases, solids, and liquids discharged to the air, sewage systems, or neighbouring waters without proper treatment.

To find out the sources and effects of various kinds of pollution in heavily industrialized areas, where oil refineries, metallurgical plants, electro-chemical processes, or smelters operate, requires time and technical experience. Basic to the problem of controlling air pollution, for example, is accurate knowledge of the distribution of dust and gases, their behaviour under different atmospheric conditions, their origin, spread, and persistence. Measurements of suspended and deposited impurities and meteorological studies of winds, humidity, and light intensities are required over a period of time before the required facts can be established to indicate methods of removal or prevention.

In older industrial countries, particularly Britain and the United States, considerable study has been done on both air and water pollution. Much of the results of this research can be adapted to conditions in Ontario.

## Air Pollution Division — Ontario Research Foundation

Technical work on air pollution is conducted for the Advisory Committee by the Ontario Research Foundation. In the Department of Chemistry of the Foundation an Air Pollution Laboratory has been set up to serve as a centre of advice and information. With assistance from the Research Council of Ontario a pool of equipment is being gathered for use in various parts of the Province. This includes two trailer vans designed as mobile laboratories. A library of technical information is being built up. Already work has been done for industrial clients who anticipate problems in pollution control.

## Group Research on Industrial Pollution

The work of the Advisory Committee has had encouraging results during the past year. The group of three corporations in the Sarnia area, which last year began a joint study of air pollution, has been enlarged to include two more companies. On a co-operative basis with the Research Council of Ontario these firms are extending the work previously conducted individually. Over the past several months a comprehensive program of testing with sulphur-dioxide recorders and dust-samplers has been carried

out and related to meteorological conditions. The costs of the co-operative research at Sarnia are shared by the Province under a provision of the Research Council of Ontario Act (see Appendix V).

The Advisory Committee has had meetings with civic representatives in other areas as well as with members of the Canadian Manufacturers Association who are interested in the study of pollution. A first-hand inspection of pollution controls now in use in Detroit and Pittsburg is planned, as well as the study of the problems affecting certain of our own densely populated areas under jurisdiction of our River Valley Conservation Authorities.

### **Canning and Dairy Wastes**

Research on cannery and milk waste disposal, sponsored in co-operation with the Department of Health during previous years, has been completed and the data presented in report form. The extension of this knowledge to the benefit of operators in the Province has been taken over by the Department of Health and the Pollution Control Board of Ontario. Some problems in the canning industry remain to be solved, and a schedule outlining a proposed research program was presented to the Canned Foods Association of Ontario as a possible basis for co-operative research.

### **University Projects**

During the past year the Civil Engineering Department at Queen's University has been allotted funds to investigate the effect of industrial wastes on the disposal of municipal sewage. This work will be conducted with pilot-plant equipment. Preliminary literature surveys have been made to orient the research, which will include comparison tests on sewage, and on sewage contaminated with varying quantities of industrial waste chemicals. It is hoped that this work will indicate remedies for those municipal areas that are experiencing difficulty in the operation of their plants.

### **Pollution Control Board of Ontario**

Members of the Advisory Committee on Industrial Waste have also had a share in the organization and operation of the Pollution Control Board of Ontario which was formed in July of 1952. The purpose of this Board is to advise the administration on effective controls for industrial and domestic pollution in the Province. The Board is advisory to the ministers of departments concerned with various aspects of pollution, principally the Departments of Health, Lands and Forests, Planning and Development, and Agriculture. Its main objectives are to co-ordinate government policy on pollution, to review legislation and procedures for dealing with pollution, to confer with municipal and industrial groups, to consider research which may be necessary for establishing a realistic basis for regulatory measures, and to look into the need for field and laboratory services.





Photo: Ontario Department of Lands and Forests

Metallographic microscope, used to study electro-plating, Ontario Research Foundation.

Inset: photo-micrograph of boundary between nickel plating and steel basis metal, as exposed by taper-sectioning, reveals scratches and steel slivers resulting from polishing.

# ADVISORY COMMITTEE OF MINES, MINERALS, AND METALLURGY

Chairman: Mr. N. F. Parkinson

Minerals and metals are becoming steadily more basic to our way of life. Their uses in the products and processes of manufacturing have even in the past twenty years undergone a fresh and momentous expansion. New metals, or new alloys of the common metals, are now vital to a multitude of specialized industries and techniques. At the turn of the century only about ten metals were used in all manufacturing, transportation, and construction. To-day the number is close to fifty. In 1941 the number of metals in the United States listed as scarce was twelve, in 1951 well over thirty.

Aided by advances in fundamental chemistry and physics, the metallurgical sciences have revolutionized the importance of metals and alloys. These are now in demand in a bewildering variety to meet special requirements of hardness, toughness, strength, elasticity, lightness, malleability, and resistance to wear, corrosion, fatigue and intense heat. The recent advent of new or previously unused metals in industry is the result primarily of research which has revealed their peculiar capabilities and solved problems of their extraction and industrial uses.

A group of relatively scarce metals, which are used in alloy with steel or copper, have for some years assumed a value out of all proportion to the quantities used. These include nickel, tungsten, chromium, cobalt, manganese, cadmium, beryllium, molybdenum, columbium. To the electrical and electronics industries the importance of such metals as tungsten, tantalum, selenium, iridium and germanium are now inestimable. Recently titanium has become a strategic metal, used extensively in the aircraft industries. Certain platinum alloys are supreme as refractories and for high-temperature hard-wearing parts. Zirconium, because it does not absorb neutrons, is in heavy demand for the construction of nuclear reactors. The light structural metals, aluminum and magnesium, are gaining ground against steel and copper on the basis of volume used, but this may be no indication of a permanent trend. Concurrently steel in new or more refined applications is not only supplanting older materials but even challenging its metallic and plastic competitors. Impending on the horizon of this ferment in metallurgy is the atomic energy industry, which will not only consume radioactive elements but also demand new knowledge of other metals.

No prediction of the future for metals can safely indicate specific tendencies, but beyond question the demand for all metals will increase in variety and quantity, the search for supplies will be intensified, and the significance of research at all levels, from geology to scrap, will become more emphatic. In the whole range of metals not more than half are yet employed to any

extent commercially. The field for research and development in mines, minerals, and metallurgy is indeed vast and promising. This is especially so for Ontario, backed by the ore wealth of the Precambrian Shield and centred in a new Canadian productive potential which last year exceeded a net output of over \$10 billions.

The activities of the Advisory Committee on Mines, Minerals, and Metallurgy have been divided between three main aspects of the field; geology and prospecting, metallurgy, and problems affecting operating mines.

### Geology and Prospecting

Most of our graduates in geophysics have in recent years entered the mining and petroleum industries. A number of these have carried out research projects for industry during the past year in connection with seismic, electro-magnetic, air-born magnetic, gravity, and radioactive methods of prospecting.

In many cases more fundamental studies, which avoid the difficulties of commercial competition and secrecy, provide as good training. This type of research, which has been supported by the Research Council of Ontario, has been centred on investigations of the fundamental process by which the earth works. The earth is an operating heat engine. Mountain building, folding of rocks, and ore depositions are secondary consequences of the thermal operation. Research papers have been published last year on measurements of heat flow and distribution of radioactivity in Ontario, while the physical processes by which the earth may operate have been reviewed and related to geology.

To interpret Precambrian geology more age determinations are needed. The Research Council of Ontario has supported research on new isotopic age determinations, and in collaboration with scientists of the Geological Survey of Canada the results of this work have been published for a number of Canadian localities. In this research two new methods are being developed which may enable ages to be approximated for such minerals as feldspar and galena. The Assay Laboratory of the Ontario Department of Mines is assisting, and at McMaster University a mass spectrometer is being used to trace variations of isotopic abundance in minerals to see whether useful information can be gained.

The Research Council of Ontario has continued to assist spectrographic Research at Queen's University which last year pursued the following projects:

- (a) The precise analysis of the platinum metals produced in sponge form from Canadian ores. This phase is in collaboration with Falconbridge Nickel Mines, Limited. Spectrographic techniques of varying character have been worked out for the analysis of refinery sponge of palladium, platinum, rhodium, and iridium.



- (b) The more exact analysis of Canadian ores containing the platinum metals, gold and silver. This is a study of fundamental importance when it is realized that assayers of platinum metals seldom agree as to the amounts of these metals present in low-grade ores where the quantities are small.
- (c) The study of trace elements in Canadian coals (Cape Breton) for the purpose of assisting in correlation and identification of individual coal seams. This work may help also to determine in coal the amount of the rare but much-sought-after metal, germanium, in which such companies as General Electric are interested.
- (d) Analyses of trace elements and major constituents of igneous rocks with which ore deposits are associated in order to aid in classifying such rocks as possible ores and differentiating them from similar rocks which are not.

Investigations in Pleistocene Geology are continuing in the London area and studies were last year published on several phases of the work. These include the following:

1. Bedrock Surface and Thickness of Pleistocene Deposits;
2. Significant Petrographic Differences in Huron and Erie Ice Lobe Tills;
3. Pleistocene Stratigraphy along the Lake Erie Shore;
4. Pleistocene Stratigraphy along the Lake Huron Shore;
5. Glacial Lakes and their Shore Lines;
6. Ground Water Studies.

During 1952-53 additional knowledge has been accumulated on the detailed Pleistocene stratigraphy of the Lake Erie Lobe tills, and new conclusions have been embodied in two papers now ready for publication.

Further studies of Pleistocene stratigraphy are planned for areas west of Port Stanley and along Lake Huron. Geophysical methods for the further study of bedrock are projected in the hope of acquiring information about buried horizons and outlining water-bearing bodies. It is planned also to retrace shore lines of certain glacial lakes because there is confusion over the manner of the postglacial warping in the London area.

## Metallurgy

Research in the last year has been concerned with the development of new methods of analysis, mainly polarographic, for the determination of titanium in steels, nickel-base alloys, aluminum alloys, and soils. Attention has also been given to the determination of lead in de-leading baths and cerium in light alloys.



The work completed on steels and nickel-base alloys has been brought to publication, and also that on aluminum alloys. A paper on the polarographic determination of aluminum in zinc alloys was presented last year at the June conference of the Chemical Institute of Canada. Projected work includes the study of new analytical methods for zirconium and cerium, and further work on the determination of titanium in soils.

Research done in metal vapours is related to the production of volatile metals. Factors controlling the evolution of calcium vapour from a mixture of calcium oxide and aluminum have been examined. The calcium vapour is evolved in a vacuum at 1100-1200° C. Apparatus for achieving these conditions in the laboratory was designed and constructed. The free energies of vaporization of the metals has been collected and plotted against temperature to produce a useful graph. This work, performed at the University of Toronto with assistance from the Research Council of Ontario, has been presented for publication to the American Institute of Mining and Metallurgical Engineers.

The work in ferrous metallurgy conducted by the Ontario Research Foundation, and to which the Research Council of Ontario has given assistance over the past few years, has considerable promise. Research to simplify the production of controlled density steel from prepared pellets of iron ore, lime, and carbon has continued, but during the year a considerable change occurred in the direction of this work. The plant at Oakville closed down in the late summer, and work on molded products was stopped until a new furnace could be built at the Foundation. Two furnaces are now operating at the Foundation — one a continuous furnace for the production of wrought products, the other a batch furnace for the production of molded products. During the year an arrangement developed between the Foundation and a client for extending the work in these fields.

## Mines

For some time the Research Council of Ontario has assisted in investigations of both destructive and non-destructive testing of wire ropes such as is used in mining and construction for hoisting purposes. This two-fold program of research is still under way. At the Ontario Research Foundation cables have been tested on a specially designed machine under conditions and stresses similar to those in mine shafts. Much data has been accumulated which may indicate some useful standard practices for the proper use of hoist cables. From this work it may also be possible to scientifically determine the required size of sheaves for the ropes used, as well as the effects of changes in "lay lengths" and diameters of ropes.

The other phase of this project is concerned with supersonic testing of wire ropes. Ropes now in use are being tested by a device which electrically

induces high-frequency mechanical waves into cables. Weakness in the metal of a cable affects the pick-up obtained beyond on a moveable probe. Graphs have been made up for each rope tested, and after removal the ropes are examined in detail by tensile tests at the Ontario Department of Mines. Comparisons are such as to offer some encouragement for the development of a reliable method of non-destructive testing. This work in supersonics is continuing as a co-operative research project, shared between the Ontario Mining Association and the Research Council of Ontario.

# ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

Chairman: Prof. K. B. Jackson

Photographic surveying has been practised in Canada for over fifty years, with considerable improvement over that period in cameras, plotting instruments, and the use of aircraft. But aerial mapping is a complicated science. Photogrammetry, as it is called, is a comparatively new field in research and development. The problems of relating a series of perspectives obtained by a camera from unknown points in space with unknown points of reference on the ground to produce a map of an irregular terrain at a constant scale are highly technical.

During the past year the Executive of the Aerial Survey Committee held two meetings at which projects in hand and plans for the future were discussed. The work sponsored by the Committee has been seriously restricted by the lack of available personnel with adequate training in the fundamentals of photogrammetry. However, this situation should steadily improve. A new option in photogrammetry is to be set up in fourth-year Civil Engineering at the University of Toronto. This will soon make it possible to assist post-graduate students in this special field who have had previous training at the undergraduate level. Post-graduate research in photogrammetry will be of interest to a number of provincial government departments and agencies who could benefit greatly by techniques of aerial surveying. It is hoped also that Canadian companies will co-operate in providing equipment for training and research in interpreting aerial photographs.

Work has been continued on "unsharp masking" as a technique for the improvement of the interpretability of aerial photographs. A quantitative analysis of the improvement in resolving power has been made which permits comparison with work on other methods directed to the same end. The preliminary work carried out by J. R. G. Smyth of the Department of Lands and Forests has been published in the Canadian Surveyor.

The study of the effects of chromatic stereoscopy on visual acuity and possible means of refractive correction, proposed a year ago, has had to be postponed for want of personnel. This, however, will be undertaken as soon as possible, as it may have some bearing on the problem of selecting stereoscopic operators.

A survey of current research is continuing, and several useful contacts with research organizations have been made by members of the Advisory Committee. Visits were made to Kodak Park Research Laboratories, and the Cornell Centre for Integrated Aerial Photographic Studies. Meetings were attended at the International Congress of Photogrammetry, The American Society of Photogrammetry, and the Canadian Institute of Surveying and

Photogrammetry. Papers on "Stereoscopic Projection with a Floating Mark" were presented at the International Congress in Washington and at Cornell University.

It is proposed to continue the study of photographic and observational techniques for the improvement of the interpretability of aerial photographs and, through a closer liaison with other committees of the Council and an appreciation of their problems, to determine if and how aerial photographs and mapping techniques may be used to advantage. The optimum scale of photography for forest type sampling, and the application of aerial photographs to soil surveys and land-use planning are examples of investigations that might well result in more effective and more economical procedures.



# APPENDIX I

## STATEMENT OF EXPENDITURE

### For the Year Ended 31st March, 1953

#### ADMINISTRATION:

Salaries .....	20,396.88	
Maintenance .....	5,049.73	
Travelling .....	4,490.15	29,936.76

SCHOLARSHIPS .....		42,470.00
GROUP RESEARCH (Government share, 50%) .....		19,967.65

#### GRANTS:

##### Ontario Research Foundation:

Wire Rope .....	13,559.85	
Ferrous Metallurgy .....	20,524.85	
Parasitology .....	36,721.87	
Wood Chemistry .....	37,452.95	
Physiography .....	25,183.73	
Utilization of Agricultural Products .....	12,584.04	
Industrial Research Services .....	84,638.53	
Physics of Metals .....	11,363.56	
Air Pollution .....	19,423.72	261,453.10

##### University of Toronto

Fisheries and Wildlife .....	28,920.00	
Mines .....	12,510.00	
Forestry .....	22,860.00	
Agriculture .....	1,560.00	
Physics .....	10,080.00	75,930.00

##### McMaster University

Fisheries and Wildlife .....	12,900.00	
Forestry .....	2,160.00	
Mines .....	2,880.00	
Physics .....	10,080.00	
Agriculture .....	3,600.00	31,620.00

##### Queen's University

Fisheries .....	7,800.00	
Mines .....	1,800.00	
Forestry .....	12,060.00	
Industrial Waste .....	10,320.00	31,980.00

##### University of Western Ontario

Fisheries and Wildlife .....	9,420.00	
Mines .....	4,860.00	
Agriculture .....	2,880.00	17,160.00

##### Ontario Agricultural College

Agriculture .....	3,820.00	3,820.00
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##### Ontario Veterinary College

Agriculture .....	900.00	900.00
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##### Department of Health

Milk Waste .....	5,216.33	5,216.33
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##### Department of Lands and Forests

Forestry, Fisheries and Wildlife .....	15,400.00	15,400.00	443,479.43
			535,853.84

## APPENDIX II

### SCHOLARSHIP AWARDS 1952-53

Name	Field	Scholarship University	Amount
AZIZ, R. A.	Physics	University of Toronto	\$ 1,000.00
ARNOLD, H. J.	Mathematics	North Carolina State College	850.00
BEDROSIAN, P.	Mathematics	McMaster University	750.00
BEST, E. W.	Geology	University of Wisconsin	1,000.00
BOURNE, N. F.	Biology	McMaster University	750.00
BRAUER, F. G.	Mathematics	Massachusetts Institute of Technology	750.00
CHISHOLM, R. M.	Electrical Engineering	University of Toronto	750.00
CHRISTIE, H. W.	Soil Chemistry	Ontario Agricultural College	850.00
COLE, A. H.	Soil Physics	Cambridge University	1,000.00
COLHOUN, E. H.	Biology	Cambridge University	1,000.00
COWPER, G. R.	Mathematics	Queen's University	750.00
CROWE, C.	Physics	University of Western Ontario	750.00
DEMPSTER, A. P.	Mathematics	University of Toronto	750.00
DEWDNEY, J. W.	Physics	McMaster University	850.00
DONNELLY, R. J.	Physics	Yale University	850.00
GEIGER, J. S.	Physics	Yale University	850.00
GHENT, A. W.	Biology	University of Toronto	850.00
GIBBS, H. H.	Chemistry	Queen's University	750.00
HALL, D. W.	Physics	Princeton University	850.00
HALLAM, J. C.	Biology	University of Toronto	750.00
HARRISON, A. G.	Chemistry	University of Western Ontario	750.00
HART, K. H.	Physics	University of Toronto	1,000.00
HAUN, D. D.	Geophysics	University of Toronto	750.00
HAYES, E. R.	Chemistry	McMaster University	1,000.00
HILLIS, MISS L. W.	Biology	University of Michigan	750.00
HOWELL, W. C.	Chemistry	University of Western Ontario	1,000.00
ISHII, MISS M.	Chemistry	McMaster University	750.00
KERR, J. T.	Physics	McMaster University	750.00
LIBIN, M. L.	Biology	University of Toronto	1,000.00
McINTOSH, B. A.	Physics	University of Western Ontario	750.00
McMILLAN, J. E.	Mathematics	University of Western Ontario	750.00
NABLO, S. V.	Physics	McMaster University	750.00
PENGELLY, D. H.	Biology	Cornell University	850.00
PLEITER, D.	Physics	University of Western Ontario	850.00
PLINT, C. A.	Physics	University of Toronto	850.00
REID, J.	Biology	McMaster University	750.00
RIDDELL, J. A.	Biology	Ontario Agricultural College	850.00
SHEPPARD, W. A.	Chemistry	Massachusetts Institute of Technology	1,000.00
SHOEMAKER, R. A.	Biology	Cornell University	1,000.00
SPROTT, D. A.	Mathematics	University of Toronto	750.00
STOREY, R. S.	Physics	Queen's University	750.00
TAYLOR, G. W.	Chemistry	Queen's University	750.00
WALTER, J. R.	Mathematics	University of Toronto	750.00
WATKINS, M. S.	Mathematics	University of Toronto	750.00
WATSON, N. W. Y.	Biology	University of Toronto	850.00
WILSON, R. L.	Physics	McGill University	750.00

## APPENDIX III

### ADVISORY COMMITTEES\*

#### AERIAL SURVEY RESEARCH

##### Main Committee:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
(Chairman)		
MR. J. A. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Ontario Department of Lands and Forests
MR. J. A. BRODIE	- -	Ontario Department of Lands and Forests
MR. L. J. CHAPMAN	- -	Ontario Research Foundation
DR. W. CLARK	- -	Eastman Kodak Co.
DR. D. R. DERRY	- -	Ventures Limited
MR. W. J. FULTON	- -	Ontario Department of Highways
DR. L. E. HOWLETT	- -	Physics, National Research Council
MR. M. E. HURST	- -	Ontario Department of Mines
MR. W. J. JACKSON	- -	Williamson Co. of Canada, Ltd.
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. S. T. B. LOSEE	- -	Abitibi Power and Paper Co. Ltd.
PROF. O. J. MARSHALL	- -	Civil Engineering, University of Toronto
PROF. F. F. MORWICK	- -	Soils, Ontario Agricultural College
PROF. J. E. REID	- -	Electrical Engineering, University of Toronto
MR. A. H. RICHARDSON	- -	Ontario Department of Planning and Development
MR. J. R. G. SMYTH	- -	Ontario Department of Lands and Forests

##### Executive:

PROF. K. B. JACKSON		Applied Physics, University of Toronto
(Chairman)		
MR. W. J. FULTON	- -	Ontario Department of Highways
MR. M. E. HURST	- -	Ontario Department of Mines
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. A. H. RICHARDSON	- -	Ontario Department of Planning and Development

##### Meetings:

March 5th, 1953, 39 Queen's Park, Toronto.

#### PHOTOGRAPHY

MR. J. A. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Ontario Department of Lands and Forests
PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation

#### PHOTOGRAMMETRY

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. K. H. SIDDALL	- -	Ontario Department of Highways
MR. L. G. TIMPSON	- -	Ontario Department of Lands and Forests
PROF. W. M. TREADGOLD	- -	Civil Engineering, University of Toronto
MR. J. G. WILKINSON	- -	Photographic Survey Corporation

\*List as at March 31st, 1953.

## AGRICULTURAL RESEARCH

### Main Committee:

PROF. G. N. RUHNKE	- -	Ontario Department of Agriculture (Chairman)
MR. A. M. BARR	- - - -	Agricultural School, Kemptville
DR. W. H. COOK	- - - -	Applied Biology, National Research Council
MR. H. CRAISE	- - - -	Ontario Federation of Agriculture
MR. L. DAVIS	- - - -	Ontario Federation of Agriculture
DR. W. P. DOBSON	- - - -	Hydro-Electric Power Commission of Ontario
MR. J. A. GARNER	- - - -	Ontario Department of Agriculture
MR. C. D. GRAHAM	- - - -	Ontario Department of Agriculture
DR. E. S. HOPKINS	- - - -	Dominion Department of Agriculture
MR. R. H. JARDINE	- - - -	Ontario Dairy Producers' Co-ordinating Board
DR. T. L. JONES	- - - -	Ontario Veterinary College
MR. C. F. LUCKHAM	- - - -	Ontario Federation of Agriculture
MR. CHARLES McINNIS	- - - -	Ontario Hog Producers Association
DR. J. D. MacLACHLAN	- - - -	Ontario Agricultural College
MR. V. S. MILBURN	- - - -	Ontario Federation of Agriculture
DR. K. W. NEATBY	- - - -	Science Service, Dominion Department of Agriculture
DR. E. F. PALMER	- - - -	Horticultural Experiment Station, Vineland
DR. H. B. SPEAKMAN	- - - -	Ontario Research Foundation
MR. J. C. STECKLEY	- - - -	Western Ontario Agricultural School & Experi- mental Farm

### Meetings:

June 9th, 1952, Royal York Hotel, Toronto.

September 9th, 1952, Royal York Hotel, Toronto.

## AGRICULTURAL ECONOMICS

DR. J. F. BOOTH	- - - -	Dominion Department of Agriculture
PROF. D. R. CAMPBELL	- - - -	Agricultural Economics, Ontario Agricultural College
MR. H. CRAISE	- - - -	Ontario Federation of Agriculture
MR. H. K. LECKIE	- - - -	Industrial & Development Council of Canadian Meat Packers
MR. V. S. MILBURN	- - - -	Ontario Federation of Agriculture
DR. C. V. PARKER	- - - -	Dominion Bureau of Statistics
DR. H. L. PATTERSON	- - - -	Ontario Department of Agriculture
MR. G. F. PERKIN	- - - -	Ontario Department of Agriculture
DEAN L. W. SIPHERD	- - - -	School of Business Administration, University of Western Ontario

### Meetings:

September 25th, 1952, 39 Queen's Park, Toronto.

November 17th, 1952, 39 Queen's Park, Toronto.

February 20th, 1953, 39 Queen's Park, Toronto.

## AGRICULTURAL ENGINEERING

MR. W. B. DENYES	- - - -	Eastern Steel Products
MR. L. M. FRANK	- - - -	Eastern Steel Products
(Alternate to Mr. Denyes)		
DR. W. P. DOBSON	- - - -	Hydro-Electric Power Commission of Ontario
PROF. C. G. E. DOWNING	- - - -	Agricultural Engineering, Ontario Agricultural College
MR. WM. KALBFLEISH	- - - -	Dominion Department of Agriculture
MR. M. H. McCURDY	- - - -	Cockshutt Farm Equipment, Ltd.



MR. R. S. McMILLAN	-	-	-	Pedlar People, Ltd.
MR. A. PITT	-	-	-	Massey-Harris Co. Ltd.
MR. W. C. WOOD	-	-	-	W. C. Wood Co.
MR. S. M. YOUNG	-	-	-	International Harvester Co. of Canada, Ltd.

## FOOD PROCESSING

MR. JOHN BAXTER	-	-	-	Baxter Canning Co.
MR. G. G. BRAMHILL	-	-	-	Ontario Department of Agriculture
MR. L. CAMPBELL	-	-	-	Ontario Research Foundation
DR. W. H. COOK	-	-	-	Applied Biology, National Research Council
DR. R. K. LARMOUR	-	-	-	Maple Leaf Milling Co.
DR. W. D. McFARLANE	-	-	-	Canadian Breweries Limited
MR. EARL S. MANNING	-	-	-	Industrial & Development Council of Canadian Meat Packers
DR. H. B. SPEAKMAN	-	-	-	Ontario Research Foundation
DR. J. H. L. TRUSCOTT	-	-	-	Horticultural Experiment Station, Vineland

## SOILS

MR. L. J. CHAPMAN	-	-	-	Ontario Research Foundation
(Chairman)				
PROF. F. E. CHASE				Bacteriology, Ontario Agricultural College
(Secretary)				
DR. H. J. ATKINSON	-	-	-	Dominion Department of Agriculture
MR. A. M. BARR	-	-	-	Agricultural School, Kemptville
MR. W. J. P. CRESWICK	-	-	-	Ontario Department of Planning and Development
MR. G. A. HILLS	-	-	-	Ontario Department of Lands and Forests
MR. R. N. JOHNSTON	-	-	-	Ontario Department of Lands and Forests
MR. LAWRENCE KERR	-	-	-	Kerr Farms, Chatham
DR. P. O. RIPLEY	-	-	-	Dominion Department of Agriculture
PROF. N. R. RICHARDS	-	-	-	Soils, Ontario Agricultural College
DR. J. W. ROUATT	-	-	-	Science Service, Dominion Department of Agriculture
MR. JOHN SMART	-	-	-	Collingwood, Ont.
MR. J. C. STECKLEY	-	-	-	Western Ontario Agricultural School and Experimental Farm
DR. W. H. UPSHALL	-	-	-	Horticultural Experiment Station, Vineland
MR. J. WALTER	-	-	-	Ontario Department of Highways

## Meetings:

October 1st, 1952, 39 Queen's Park, Toronto.  
November 12th, 1952, Ontario Agricultural College, Guelph.  
March 17th, 1953, Southern Research Station, Maple.

## FISHERIES AND WILDLIFE RESEARCH

### Main Committee:

DR. J. R. DYMOND	-	-	-	Zoology, University of Toronto
(Chairman)				
DR. A. M. FALLIS	-	-	-	Parasitology, Ontario Research Foundation
(Secretary)				
DR. H. I. BATTLE	-	-	-	Zoology and Applied Biology, University of Western Ontario
DR. A. O. BLACKHURST	-	-	-	Ontario Federation of Commercial Fishermen
PROF. A. F. COVENTRY	-	-	-	Zoology, University of Toronto
MR. C. D. FOWLE	-	-	-	Ontario Department of Lands and Forests
DR. F. E. J. FRY	-	-	-	Zoology, University of Toronto
DR. H. M. GOOD	-	-	-	Biology, Queen's University
DR. W. J. K. HARKNESS	-	-	-	Ontario Department of Lands and Forests

MR. L. HUGHES	- - -	Northern Ontario Outfitters' Association
DR. F. P. IDE	- - -	Zoology, University of Toronto
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
DR. H. KLEEREKOPER	- -	Zoology, McMaster University
MR. CARL F. KOLBE	- - -	Ontario Federation of Commercial Fishermen
DR. R. R. LANGFORD	- -	Zoology, University of Toronto
MR. H. H. MacKAY	- - -	Ontario Department of Lands and Forests
MR. CECIL MARTIN	- - -	Port Dover, Ontario
MR. K. M. MAYALL	- - -	Ontario Department of Planning and Development
DR. N. W. RADFORTH	- -	Botany, McMaster University
DR. D. M. SCOTT	- - -	Zoology and Applied Biology, University of Western Ontario
DR. J. H. SOPER	- - -	Botany, University of Toronto
DR. F. A. URQUHART	- -	Royal Ontario Museum of Zoology
MR. C. A. WALKINSHAW	-	Toronto, Ontario

#### Meetings:

November 8th, 1952, 39 Queen's Park, Toronto.

February 26th, 1953, 39 Queen's Park, Toronto.

#### Executive:

DR. J. R. DYMOND	- - -	Zoology, University of Toronto
(Chairman)		
DR. A. M. FALLIS	- - -	Parasitology, Ontario Research Foundation
(Secretary)		
PROF. A. F. COVENTRY	-	Zoology, University of Toronto
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. W. J. K. HARKNESS	- -	Ontario Department of Lands and Forests
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
DR. N. W. RADFORTH	- -	Botany, McMaster University

#### Meetings:

December 11th, 1952, 39 Queen's Park, Toronto.

February 6th, 1953, 39 Queen's Park, Toronto.

#### PUBLICITY

MR. K. M. MAYALL	- - -	Ontario Department of Planning and Development
(Chairman)		
MR. A. L. FENWICK	- - -	Ontario Department of Lands and Forests
DR. N. W. RADFORTH	- -	Botany, McMaster University

#### Meetings:

A number of informal meetings were held

#### RESEARCH ON BOTANICAL SUBJECTS IN RELATION TO WILDLIFE

DR. J. H. SOPER	- - -	Botany, University of Toronto
(Chairman)		
MR. N. S. BALDWIN	- -	Ontario Department of Lands and Forests, Maple
MR. J. F. S. BENDELL	- -	Biology, Queen's University
DR. R. O. BIBBEY	- - -	Botany, Ontario Agricultural College
DR. C. H. D. CLARKE	- -	Ontario Department of Lands and Forests
MR. F. S. COOK	- - -	Botany, University of Western Ontario
MR. C. D. FOWLE	- - -	Ontario Department of Lands and Forests, Maple
DR. W. J. K. HARKNESS	- -	Ontario Department of Lands and Forests
(Alternate to Dr. Clarke)		
MR. K. M. MAYALL	- - -	Ontario Department of Planning and Development

DR. N. W. RADFORTH - - - Botany, McMaster University  
 MR. C. R. TILT - - - - Ontario Department of Lands and Forests, Maple

#### Meetings:

December 4th, 1952, Ontario Research Foundation, Toronto.  
 January 26th, 1953, Ontario Research Foundation, Toronto.

## FORESTRY RESEARCH

#### Main Committee:

DEAN J. W. B. SISAM - - - Forestry, University of Toronto  
 (Chairman)  
 DR. H. B. MARSHALL - - - Ontario Research Foundation  
 (Secretary)  
 MR. A. S. L. BARNES - - - Ontario Department of Planning and Development  
 DR. R. M. BELYEA - - - Forest Insect Laboratory, Sault Ste. Marie  
 MR. W. A. DELAHEY - - - Consulting Forester  
 PROF. C. G. E. DOWNING - - - Agricultural Engineering, Ontario Agricultural  
 College  
 PROF. G. H. DUFF - - - Botany, University of Toronto  
 DEAN R. O. EARL - - - Faculty of Arts, Queen's University  
 MR. D. A. GILLIES - - - Gillies Bros. & Co. Ltd.  
 MR. J. H. GODDEN - - - Great Lakes Paper Company  
 MR. GORDON GODWIN - - - The Ontario Paper Co. Limited  
 MR. J. D. B. HARRISON - - - Dominion Dept. Resources and Development  
 DR. O. HOLDEN - - - Hydro-Electric Power Commission of Ontario  
 PROF. R. C. HOSIE - - - Forestry, University of Toronto  
 COL. J. H. JENKINS - - - Dominion Dept. of Resources and Development  
 MR. R. N. JOHNSTON - - - Ontario Department of Lands and Forests  
 MAJ. GEN. H. KENNEDY - - - Consulting Engineer  
 MR. A. KOROLEFF - - - Pulp and Paper Research Institute of Canada  
 MR. W. J. LeCLAIR - - - Canadian Lumbermen's Association  
 MR. A. P. LESLIE - - - Ontario Department of Lands and Forests  
 MR. D. A. MACDONALD - - - Dominion Department of Resources and  
 Development  
 MR. J. B. MATTHEWS - - - Abitibi Power and Paper Company Ltd.  
 DR. R. R. McLAUGHLIN - - - Chemical Engineering, University of Toronto  
 MR. C. R. MILLS - - - Ontario Forest Industries Association  
 MR. G. W. PHIPPS - - - Kimberly-Clark Corporation  
 MR. K. O. ROOS - - - Booth Lumber Limited  
 MR. S. J. STANIFORTH - - - Staniforth Lumber & Veneer Limited  
 DR. G. H. TOMLINSON II - - - Howard Smith Paper Mills Limited  
 DR. L. T. WHITE - - - Dominion Laboratory of Forest Pathology

#### Meetings:

May 15th and 16th, 1952, Forest Ranger School, Dorset  
 October 10th, 1952, Faculty of Forestry, University of Toronto.

#### Executive:

DEAN J. W. B. SISAM - - - Forestry, University of Toronto  
 (Chairman)  
 DR. H. B. MARSHALL - - - Ontario Research Foundation  
 (Secretary)  
 MR. A. S. L. BARNES - - - Ontario Department of Planning and Development  
 MR. R. N. JOHNSTON - - - Ontario Department of Lands and Forests  
 MR. J. B. MATTHEWS - - - Abitibi Power and Paper Company Ltd.  
 DR. R. R. McLAUGHLIN - - - Chemical Engineering, University of Toronto

### Meetings:

April 3rd, 1952, 39 Queen's Park, Toronto.

October 10th, 1952, Faculty of Forestry, University of Toronto.

January 15th, 1953, 39 Queen's Park, Toronto.

### FIRE CONTROL

MR. J. B. MATTHEWS	- - -	Abitibi Power and Paper Company Ltd.
(Chairman)		
MR. M. H. BAKER	- - -	Ontario Department of Lands and Forests
MR. A. S. L. BARNES	- - -	Ontario Department of Planning and Development
MR. J. C. DILLON	- - -	Ontario Department of Lands and Forests
MR. Q. F. HESS	- - -	Ontario Department of Lands and Forests
MR. R. N. JOHNSTON	- - -	Ontario Department of Lands and Forests
PROF. A. S. MITCHELL	- - -	Forestry, University of Toronto
MR. JAMES RUXTON	- - -	Ontario Department of Lands and Forests
DEAN J. W. B. SISAM	- - -	Forestry, University of Toronto

### WOOD CHEMISTRY

DR. H. B. MARSHALL	- - -	Ontario Research Foundation
(Chairman)		
DR. G. A. ADAMS	- - -	Applied Biology, National Research Council
DR. F. BENDER	- - -	Forest Products Laboratory of Canada
DR. G. A. LEDINGHAM	- - -	National Research Council Regional Laboratory, Saskatoon
DR. R. R. McLAUGHLIN	- - -	Chemical Engineering, University of Toronto
DR. G. H. TOMLINSON II	- - -	Howard Smith Paper Mills Limited

### Meetings:

November 27th and 28th, 1952, Queen's University, Kingston.

### FOREST BIOLOGY

MR. A. P. LESLIE	- - -	Ontario Department of Lands and Forests
(Chairman)		
MR. A. B. BAIRD	- - -	Dominion Department of Agriculture
PROF. G. H. DUFF	- - -	Botany, University of Toronto
DEAN R. O. EARL	- - -	Faculty of Arts, Queens University
PROF. R. C. HOSIE	- - -	Forestry, University of Toronto
MR. R. N. JOHNSTON	- - -	Ontario Department of Lands and Forests
MR. G. W. PHIPPS	- - -	Kimberley-Clark Corporation
DEAN J. W. B. SISAM	- - -	Forestry, University of Toronto
MR. W. E. WILLSON	- - -	Abitibi Power and Paper Company Ltd.

### Meetings:

September 22nd, 1952, 39 Queen's Park, Toronto.

November 27th and 28th, 1952, Queen's University, Kingston.

### FOREST RESEARCH IN NORTHWESTERN ONTARIO

MR. N. F. LYON	- - -	Ontario Department of Lands and Forests
(Chairman)		
MR. J. T. BASHAM	- - -	Dominion Department of Agriculture
MR. G. H. D. BEDELL	- - -	Dominion Dept. of Resources and Development
MR. J. H. GODDEN	- - -	Great Lakes Paper Company Limited
MR. K. HEARNDEN	- - -	Abitibi Power and Paper Company Ltd.
MR. H. O. KANTOLA	- - -	Newaygo Timber Company Limited
MR. GEO. R. SONLEY	- - -	Marathon Paper Mills of Canada Limited
MR. J. B. THOMAS	- - -	Forest Insect Laboratory, Sault Ste. Marie



MR. T. S. JONES	- - -	Thunder Bay Timber Operators' Association
(ex officio)		
MR. R. N. JOHNSTON	- -	Ontario Department of Lands and Forests
(ex officio)		
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
(ex officio)		
PROF. J. O. WILHELM	- -	Research Council of Ontario
(ex officio)		

#### Meetings:

May 8th, 1952, Prince Arthur Hotel, Port Arthur.

#### SAWMILLING PRACTICE:

MR. W. J. LeCLAIR	- - -	Canadian Lumbermen's Association
(Chairman)		
COL. J. H. JENKINS	- - -	Dominion Dept. of Resources and Development
DR. H. B. MARSHALL	- -	Ontario Research Foundation
MR. T. A. McELHANNEY	- -	Grimsby
MR. K. O. ROOS	- - -	Booth Lumber Limited
MR. J. F. SHARPE	- - -	Ontario Department of Lands and Forests
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
MR. S. J. STANFORTH	- -	Staniforth Lumber & Veneer Limited
MR. G. J. THOMSON	- - -	Peter Thomson & Sons

#### Meetings:

May 14th and 15th, 1952, Forest Ranger School, Dorset.

March 6th, 1953, Forestry Building, University of Toronto.

### HIGHWAYS RESEARCH

#### Main Committee:

MR. A. K. HAY	- - -	Federal District Commission
(Chairman)		
MR. H. N. LAMONT	- - -	Ontario Department of Highways
(Secretary)		
MR. T. N. CARTER	- - -	Carter Construction Co. Ltd.
MR. L. J. CHAPMAN	- - -	Ontario Research Foundation
MR. W. A. CLARKE	- - -	Ontario Department of Highways
MR. C. B. CRAWFORD	- -	Building Research, National Research Council
MR. D. J. EMREY	- - -	County Engineer, Kitchener
MR. T. F. FRANCIS	- - -	Ontario Department of Highways
MR. W. J. FULTON	- - -	Ontario Department of Highways
MR. W. B. HASTINGS	- -	Ontario Motor League
MR. R. A. LOW	- - -	Dominion Dept. of Resources and Development
MR. P. McCANN	- - -	Toronto Transportation Commission
MR. W. S. McKAY	- - -	Ontario Good Roads Association
DR. N. W. McLEOD	- - -	Imperial Oil Limited
MR. W. J. MOORE	- - -	Ontario Municipal Board
MR. C. A. ROBBINS	- - -	Ontario Department of Highways
MR. D. O. ROBINSON	- - -	Canada Cement Co.
PROF. W. L. SAGAR	- -	Civil Engineering, University of Toronto
MR. J. WALTER	- - -	Ontario Department of Highways
MR. R. B. YOUNG	- - -	Ontario Hydro-Electric Commission of Ontario
MR. JAMES GAW	- - -	Ontario Good Roads Association
(ex officio)		
MR. D. E. McQUIGGE	- -	Ontario Roadbuilder Association
(ex officio)		

## Meetings:

October 31st, 1952, 39 Queens' Park, Toronto.

## Executive:

MR. A. K. HAY	- - - -	Federal District Commission
(Chairman)		
MR. H. N. LAMONT	- - -	Ontario Department of Highways
(Secretary)		
MR. D. J. EMREY	- - - -	County Engineer, Kitchener
MR. T. F. FRANCIS	- - -	Ontario Department of Highways
MR. W. J. FULTON	- - -	Ontario Department of Highways
DR. N. W. McLEOD	- - -	Imperial Oil Limited
PROF. W. L. SAGAR	- - -	Civil Engineering, University of Toronto
MR. J. WALTER	- - - -	Ontario Department of Highways

## Meetings:

February 10th, 1953, Royal York Hotel, Toronto.

## TRAFFIC AND PLANNING:

MR. W. J. FULTON	- - -	Ontario Department of Highways
(Chairman)		
MR. A. E. K. BUNNELL	- -	Ontario Dept. of Planning and Development
MR. W. A. CLARKE	- - -	Ontario Department of Highways
MR. R. A. LOW	- - -	Dominion Dept. of Resources and Development
MR. G. R. MARSTON	- - -	County Engineer, Simcoe
MR. J. M. MacINNIS	- - -	Ontario Department of Highways
MR. J. L. ZOLLER	- - -	Ontario Department of Highways

## DESIGN:

MR. D. J. EMREY	- - - -	County Engineer, Kitchener
(Chairman)		
MR. T. F. FRANCIS	- - -	Ontario Department of Highways
MR. R. M. LEE	- - -	County Engineer, Brantford
DR. N. W. McLEOD	- - -	Imperial Oil Limited
MR. D. G. RAMSAY	- - -	Ontario Department of Highways
MR. D. O. ROBINSON	- - -	Canada Cement Co.
MR. J. WALTER	- - - -	Ontario Department of Highways

## SOILS AND FOUNDATIONS:

MR. J. WALTER	- - - -	Ontario Department of Highways
(Chairman)		
MR. D. J. EMREY	- - - -	County Engineer, Kitchener
MR. R. A. LOW	- - - -	Dominion Dept. of Resources and Development
MR. A. D. McGINNIS	- - -	McGinnis and O'Connor
DR. N. W. McLEOD	- - -	Imperial Oil Limited
MR. D. G. WATT	- - - -	Ontario Hydro-Electric Power Commission

## MATERIALS AND CONSTRUCTION:

MR. D. O. ROBINSON	- - -	Canada Cement Co.
(Chairman)		
MR. T. F. FRANCIS	- - -	Ontario Department of Highways
MR. C. FRASER	- - - -	Ontario Department of Highways
MR. E. W. JONES	- - - -	County Engineer, Barrie
MR. R. KELLY	- - - -	W. L. Ballentine Co. Ltd.
MR. J. A. KNIGHT	- - -	Brunner Mond Canada Sales, Ltd.
MR. H. N. LAMONT	- - -	Ontario Department of Highways
MR. J. LANGMAN	- - -	King Paving Company Limited
MR. J. V. LUDGATE	- - -	Ontario Department of Highways
MR. B. MATSON	- - - -	Ontario Rock Ltd.

DR. N. W. McLEOD	- - -	Imperial Oil Limited
PROF. W. L. SAGAR	- - -	Civil Engineering, University of Toronto
MR. C. G. SAUNDERS	- - -	Ontario Department of Highways
MR. J. WALTER	- - -	Ontario Department of Highways

## INDUSTRIAL RESEARCH

### Main Committee:

MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries, Ltd. (Chairman)
MR. D. W. STEWART, JR.	-	Renfrew (Vice-Chairman)
COL. D. F. MacRAE	- - -	Ontario Research Foundation (Secretary)
MR. LORNE C. ANDERSON	-	Ontario Paper Co. Limited
MR. G. C. BERNARD	- - -	Canadian Manufacturers' Association Inc.
MR. LORNE S. CAMPBELL	-	Ontario Dept. of Planning and Development
MR. HOWARD CHAMBERLAIN	-	Lowe Brothers Co. Ltd.
MR. T. A. FAUST	- - -	Yocum Faust, Limited
MR. R. W. KEELEY	- - -	Bendix-Eclipse of Canada Limited
COL. F. J. LYLE	- - -	Ontario Dept. of Planning and Development
MR. D. ALAN PAGE	- - -	Mercury Mills Limited
MR. T. V. PROCTOR	- - -	Libby, McNeill & Libby of Canada, Limited
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation
MR. W. R. STADELMAN	- - -	Ontario Research Foundation
MR. D. B. STRUDLEY	- - -	Imperial Furniture Mfg. Co. Limited
MR. J. N. SWINDEN	- - -	Great Lakes Lumber and Shipping, Ltd.
MR. KERGAN WELLS	- - -	W. W. Wells, Limited

### Meetings:

April 30th, 1952, Hart House, Toronto.  
 September 17th, 1952, Hart House, Toronto.  
 October 29th, 1952, Hart House, Toronto.  
 December 12th, 1952, Royal York Hotel, Toronto.  
 February 13th, 1953, Hart House, Toronto.

## INDUSTRIAL RESEARCH SERVICES:

MR. D. W. STEWART, JR.	- -	Renfrew (Chairman)
MR. LORNE C. ANDERSON	-	Ontario Paper Co. Limited
MR. HOWARD CHAMBERLAIN	-	Lowe Brothers Co. Ltd.
MR. R. W. KEELEY	- - -	Bendix-Eclipse of Canada Limited
COL. F. J. LYLE	- - -	Ontario Dept. of Planning and Development
MR. G. C. BERNARD	- - -	Canadian Manufacturers' Association Inc. (ex officio)
COL. D. F. MacRAE	- - -	Ontario Research Foundation (ex officio)
MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries, Ltd. (ex officio)
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation (ex officio)
PROF. J. O. WILHELM	- -	Research Council of Ontario (ex officio)

### Meetings:

January 19th, 1953, 39 Queen's Park, Toronto.

## GROUP RESEARCH:

MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries, Ltd.
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation
DR. R. K. STRATFORD	- - -	Imperial Oil Limited
MR. D. B. STRUDLEY	- - -	Imperial Furniture Mfg. Co. Limited
MR. KERGAN WELLS	- - -	W. W. Wells, Limited
PROF. J. O. WILHELM	- - -	Research Council of Ontario

## INDUSTRIAL WASTE RESEARCH

### Main Committee:

PROF. A. C. PLEWES	- - -	Chemical Engineering, Queen's University (Chairman)
PROF. R. R. McLAUGHLIN	-	Chemical Engineering, University of Toronto (Vice-Chairman)
DR. A. E. BERRY	- - -	Ontario Department of Health
MR. G. A. H. BURN	- - -	Ontario Department of Health
MR. A. V. DeLAPORTE	- - -	Ontario Department of Health
DR. W. J. K. HARKNESS	- - -	Ontario Department of Lands and Forests
PROF. J. D. LEE	- - -	Civil Engineering, Queen's University
MR. H. S. MATTHEWS	- - -	Matthews-Wells Company Limited
MR. ALEX D. McRAE	- - -	Imperial Oil Limited
MR. W. C. MILLER	- - -	City Engineer, St. Thomas
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation

### Meetings:

April 8th, 1952, 39 Queen's Park, Toronto.  
June 13th, 1952, Royal York Hotel, Toronto.  
October 3rd, 1952, 39 Queen's Park, Toronto.  
December 12th, 1952, 39 Queens Park, Toronto.  
February 13th, 1953, 39 Queen's Park, Toronto.

## ST. CLAIR RIVER POLLUTION:

MR. L. D. DOUGAN	- - -	Polymer Corporation Ltd. (Chairman)
DR. A. E. BERRY	- - -	Ontario Department of Health
MR. F. BREMNER	- - -	Dow Chemical of Canada, Limited
MR. R. N. JOHNSTON	- - -	Ontario Department of Lands and Forests
MR. ALEX. D. McRAE	- - -	Imperial Oil Limited
PROF. A. C. PLEWES	- - -	Chemical Engineering, Queen's University
PROF. J. O. WILHELM	- - -	Research Council of Ontario (ex officio)

### Meetings:

April 8th, 1952, 39 Queen's Park, Toronto.  
May 19th, 1952, Sarnia Golf Club.  
February 25th, 1953, Polymer Corporation, Sarnia.

## MINES, MINERALS AND METALLURGY RESEARCH

### Main Committee:

MR. N. F. PARKINSON	- - -	Ontario Mining Association (Chairman)
MR. T. H. ADAIR	- - -	Atlas Steel Company
PROF. H. S. ARMSTRONG	-	Geology, McMaster University
PROF. O. A. CARSON	- - -	Metallurgy, Queen's University



DR. O. W. ELLIS	- - -	Ontario Research Foundation
DR. G. S. FARNHAM	- - -	International Nickel Company of Canada Limited
PROF. J. E. HAWLEY	- - -	Mineralogy, Queen's University
MR. G. S. HUME	- - -	Dominion Dept. of Mines and Technical Surveys
PROF. G. B. LANGFORD	- - -	Geology, University of Toronto
MR. J. MacRAE	- - -	Dome Exploration Co.
PROF. L. M. PIDGEON	- - -	Metallurgical Engineering, University of Toronto
PROF. G. H. REAVELY	- - -	Geology, University of Western Ontario
MR. H. C. RICKABY	- - -	Ontario Department of Mines
MR. R. H. RIMMER	- - -	Aluminium Laboratories Ltd.
MR. W. A. ROLLIFF	- - -	Imperial Oil Limited
MR. W. SAMUEL	- - -	Steep Rock Iron Mines Ltd.
DR. C. R. WHITTEMORE	- - -	Deloro Smelting & Refining Co. Ltd.
DR. G. E. WILLEY	- - -	Algoma Steel Corporation, Ltd.
PROF. C. G. WILLIAMS	- - -	Toronto
PROF. J. T. WILSON	- - -	Physics, University of Toronto
MR. R. B. YOUNG	- - -	Hydro-Electric Power Commission of Ontario

#### Executive:

MR. N. F. PARKINSON	- - -	Ontario Mining Association
(Chairman)		
DR. O. W. ELLIS	- - -	Ontario Research Foundation
PROF. G. B. LANGFORD	- - -	Geological Sciences, University of Toronto
MR. H. C. RICKABY	- - -	Ontario Department of Mines
DR. C. R. WHITTEMORE	- - -	Deloro Smelting & Refining Co. Ltd.
PROF. C. G. WILLIAMS	- - -	Toronto
MR. R. B. YOUNG	- - -	Hydro-Electric Power Commission of Ontario

#### Meetings:

April 4th, 1952, 39 Queen's Park, Toronto.

#### WIRE ROPE:

DR. O. W. ELLIS	- - -	Ontario Research Foundation
(Chairman)		
MR. I. A. USHER	- - -	Ontario Research Foundation
(Secretary)		
MR. N. B. BROWN	- - -	Dominion Dept. of Mines and Technical Surveys
MR. W. E. BROWN	- - -	B. Greening Wire Co. Ltd.
MR. R. E. DYE	- - -	Dome Mines Ltd.
MR. A. C. HALFERDAHL	- - -	National Research Council
MR. R. L. HEALY	- - -	Wright-Hargreaves Mines Ltd.
MR. J. G. MORROW	- - -	Steel Company of Canada Ltd.
MR. R. D. PARKER	- - -	International Nickel Co. of Canada, Ltd.
MR. N. F. PARKINSON	- - -	Ontario Mining Association
MR. R. S. SEGSWORTH	- - -	General Engineering Co. (Canada) Ltd.
MR. D. G. SINCLAIR	- - -	Ontario Department of Mines
MR. L. W. SPROULE	- - -	Imperial Oil Ltd.
DR. D. G. WATT	- - -	Hydro-Electric Power Commission of Ontario

#### Meetings:

November 11th, 1952, Ontario Research Foundation, Toronto.

#### FERROUS METALLURGY:

DR. O. W. ELLIS	- - -	Ontario Research Foundation
(Chairman)		
MR. P. E. CAVANAGH	- - -	Ontario Research Foundation
(Secretary)		
MR. T. W. HARDY	- - -	Climax Molybdenum Company

MR. F. A. LOOSLEY	- - -	Dominion Foundries and Steel Ltd.
MR. N. F. PARKINSON (ex officio)	- -	Ontario Mining Association
MR. W. SAMUEL	- - -	Steep Rock Iron Mines Ltd.
MR. R. J. TRAILL	- - -	Dominion Dept. of Mines and Technical Surveys
MR. D. G. WATT	- - -	Hydro-Electric Power Commission of Ontario
DR. G. E. WILLEY	- - -	Algoma Steel Corporation Ltd.
MR. R. B. YOUNG	- - -	Hydro-Electric Power Commission of Ontario
MR. T. H. ADAIR (Co-operating)	- - -	Atlas Steel Company
PROF. G. LETENDRE (Co-operating)	- - -	Laval University
MR. J. S. McMAHAN (Co-operating)	- - -	Steel Co. of Canada, Ltd.
DR. NORMAN PARLES (Co-operating)	- -	Dominion Steel and Coal Co.

#### Meetings:

April 4th, 1952, Pilot Plant, Oakville.

#### GEOLOGY:

PROF. G. B. LANGFORD (Chairman)	- -	Geological Sciences, University of Toronto
MR. J. O. GORMAN	- - -	Hydro-Electric Power Commission of Ontario
PROF. J. E. HAWLEY	- - -	Mineralogy, Queen's University
DR. D. F. HEWITT	- - -	Ontario Department of Mines
MR. M. E. HURST	- - -	Ontario Department of Mines
DR. H. S. SCOTT	- - -	Physics, McMaster University

#### NON-FERROUS METALLURGY:

DR. C. R. WHITTEMORE (Chairman)	- -	Deloro Smelting & Refining Co. Ltd.
DR. O. W. ELLIS	- - -	Ontario Research Foundation
DR. G. S. FARNHAM	- - -	International Nickel Co. of Canada Limited
MR. W. M. GOODWIN	- - -	Dominion Dept. of Mines and Technical Surveys
MR. L. J. LICHTY	- - -	Ventures, Ltd.
DR. L. M. PIDGEON	- - -	Metallurgical Engineering, University of Toronto
MR. M. J. TAMPLIN	- - -	Falconbridge Nickel Mines

## APPENDIX IV

### GRANTS IN AID OF RESEARCH

#### AGRICULTURE

Project Title	Agency	Grantee	Amount
Minor Element Deficiencies in Horticultural Crops	Ont. Agricultural College	J. S. Shoemaker	\$3,100.00
Control of "Ansatospora" Storage Rot of Celery	Horticultural Experiment Station	J. H. Truscott	720.00
Studies in Bovine Sterility	Ont. Veterinary College	J. A. Henderson	900.00
Enzymic Transpeptidation Reactions	Univ. of Toronto	C. S. Hanes	1,560.00
Virus Disease of Wildlife Food Plants in the Royal Botanical Gardens	McMaster Univ.	W. D. MacClement	1,440.00
Ecological Investigations on Soil Micro-organisms	McMaster Univ.	J. J. Miller	2,160.00
Soil-Microflora in Relation to the Incidence of Common Scab of Potato	Univ. of Western Ontario	A. R. Walker	2,880.00
Farm Products Utilization	Ont. Research Foundation	L. A. Campbell	12,584.04
Physiography	Ont. Research Foundation	L. J. Chapman	25,183.73

#### FISHERIES AND WILDLIFE

Bibliographic Research	Univ. of Toronto	J. R. Dymond	19,800.00
Library, Ont. Fish. Res. Lab.			
Bibliography of Canadian Biology			
Physiology of Ontario Fish			
Plankton Collection Methods			
Alewife Investigation			
Lamprey Investigation			
Toxicity of Pollutants			
Chemistry of Polluted Waters			
Ecology of Stream Insects			
Physical Factors in Environment of Deer Mice	Univ. of Toronto	J. H. Soper	3,600.00
Miscellaneous Small Mammal Studies			
Distribution of Vascular Plants in Ontario			
Utilization of Bottom Organisms, Primarily Chironomid Larvae as food for fishes	Queen's Univ.	H. W. Curran	7,800.00
Analyses of the Alimentary Tract of Chironomid larvae to determine the kinds and relative amounts of phytoplankton ingested			
Comparison of 3 different types of neighbouring lakes as to chemical-physical features and fish production, especially as regards the availability of large mouth bass			
Oxygen content of the blood of large mouth bass in relation to its environment			
Studies on Black Flies	McMaster Univ.	D. M. Davies	1,320.00
Population Study of the Penn. Field Mouse	McMaster Univ.	D. E. Delzell	1,320.00

Lake Bottom Sediments	McMaster Univ.	H. Kleerekoper	5,760.00
Floristic Survey of the Eastern Portion of the North Shore of Lake Erie	McMaster Univ.	L. Laking	2,700.00
Biology of Mosquitoes in the Vicinity of London, Ontario	Univ. of Western Ontario.	W. W. Judd	1,500.00
Limnology of Lake Erie	Univ. of Western Ontario.	D. M. Scott	5,760.00
Ecology of Mamals in Rondeau Park	Univ. of Western Ontario	R. H. Stinson	2,160.00
Taxonomy and Ecology of the Wolf in Southern Ontario			
Taxonomic and Ecological Survey of Plant Life in Cootes Paradise	McMaster Univ.	N. W. Radforth	1,800.00
Mammals of Arctic and Eastern Canada	Royal Ontario Museum	F. A. Urquhart	5,520.00
Animal Populations			
Lake Erie Cisco Year Classes			
Study of Ecto-Parasites	Depts. of Lands and Forests	N. D. Martin	1,900.00
Bird Populations			
Experiments in Winter Smelt Fishing	Depts. of Lands and Forests	F. Fry	3,500.00
Wildlife Studies in Algonquin Park	Depts. of Lands and Forests	R. N. Johnston	5,000.00
Parasitology	Ont. Research Foundation	A. M. Fallis	36,721.87

## FORESTRY

Forest Tree Mycorrhiza	Univ. of Toronto	G. H. Duff	5,880.00
Development Plant Physiology			
Relation of Growth and Respiration to Water Intake	Univ. of Toronto	R. C. Hosie	1,680.00
Forest Regeneration in Ontario	Univ. of Toronto	G. McCasland	1,020.00
Stereochemistry of the Cyclitols	Univ. of Toronto	W. G. McIntosh	3,360.00
Sawmilling and Barking Research	Univ. of Toronto	R. R. McLaughlin	4,320.00
Butyl Acetate Extraction of Waste Sul- phite Liquor	Univ. of Toronto	R. R. McLaughlin	4,320.00
Woodlots Economic Study	Univ. of Toronto	J. W. B. Sisam	6,600.00
Silvicultural Studies			
Forest Genetics	McMaster Univ.	A. N. Bourns	2,160.00
Liquid Phase Oxidation of p-cymene	Queen's Univ.	R. O. Earl	1,440.00
Investigation of "Sick Soil" and Anti- biotics	Queen's Univ.	H. M. Good	3,660.00
Decay of Maple with reference to Succes- sion	Queen's Univ.	G. Krotkov	3,480.00
Infection of Wounds by Decay Fungi			
Biochemistry and Physiology of Can. Woods	Queen's Univ.	G. Krotkov	3,480.00
Insect Microbiology	Queen's Univ.	A. S. West	3,480.00
Application of Precipitin Test to Ento- mological Research			
Forest Genetics	Dept. of Lands and Forests	C. Heimburger	5,000.00
Wood Chemistry	Ont. Research Foundation	H. B. Marshall	37,452.95

## INDUSTRIAL RESEARCH

Industrial Research Services	Ont. Research Foundation	D. F. MacRae	84,638.53
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## INDUSTRIAL WASTE

Effect of Synthetic Detergents on Sewage Treatment Processes	Queen's Univ.	J. D. Lee	9,600.00
Vaporization of Liquid Mistures in Air Streams	Queen's Univ.	A. C. Plewes	720.00
Air Pollution	Ont. Research Foundation	A. E. R. Westman	19,423.72
Milk Wastes	Dept. of Health	A. V. Delaporte	5,216.33

## MINES, MINERALS AND METALLURGY

Crystal Boundaries in Iron and Steel	Univ. of Toronto	B. Chalmers	3,030.00
Mineralogy of Radioactive Minerals	Univ. of Toronto	G. B. Langford	2,400.00
Production of Metal Vapours by Chemical Reaction	Univ. of Toronto	L. M. Pidgeon	4,200.00
Geophysics Research	Univ. of Toronto	J. T. Wilson	2,880.00
Polarographic Analysis of Alloys	McMaster Univ.	R. P. Graham	2,880.00
Spectrographic Studies	Queen's Univ.	J. E. Hawley	1,800.00
Probe Method of Measuring Conductivity	Univ. of Western Ontario	A. D. Misener	3,000.00
Pleistocene Investigation in Southwestern Ontario	Univ. of Western Ontario	G. H. Reavely	1,860.00
Ferrous Metallurgy	Ont. Research Foundation	O. W. Ellis	20,524.85
Wire Rope	Ont. Research Foundation	O. W. Ellis	13,559.85
Physics of Metals	Ont. Research Foundation	P. E. Cavanagh	11,363.56

## PHYSICS

Atomic Mass Measurements	McMaster Univ.	H. E. Duckworth	10,080.00
Low Temperature Physics	Univ. of Toronto	W. H. Watson	10,080.00

## GROUP RESEARCH<sup>1</sup>

	Co-Operating Companies		
Supersonic Method of Testing Wire Rope	Ontario Mining Association		5,217.65
St. Clair River Pollution	Dow Chemical of Canada Limited		
	Polymer Corporation		
	Imperial Oil Limited		5,000.00
Canners Group Research	Campbell Soup Company		
	Canadian Canners Limited		
	Bright Canning Company		
	Tip Top Canners		
	E. D. Smith and Sons		3,000.00
Silviculture	The Ontario Paper Co. Limited		
	Abitibi Power and Paper Co. Ltd.		6,750.00
			<hr/> \$463,447.08 <hr/>

(1) Research Council of Ontario share — 50%; industry share 50%.

## APPENDIX V

### BILL No. 114

4th SESSION, 22nd LEGISLATURE, ONTARIO

12 GEORGE VI, 1948

An Act Respecting the Research Council of Ontario

MR. MICHENER

HIS MAJESTY, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows:

Interpretation,—

1. In this Act,—
  - (a) "Council" means Research Council of Ontario;
  - (b) "Minister" means the member of the Executive Council to whom the administration of this Act is assigned by the Lieutenant-Governor in Council.
2. There shall be a body corporate to be known as the Research Council of Ontario composed of not more than twelve members appointed by the Lieutenant-Governor in Council, and having for its object the betterment of industrial, agricultural and other research and scientific activity in Ontario as a means to the utilization of the resources of the Province.
3. Each member of the Council shall be appointed for a term of three years from the date of his appointment, except that of the first appointments not more than four members may be appointed for four years and not more than four members for five years, so as to establish a system of retirement in rotation, and a member shall be eligible for re-appointment for one additional term of three years.
4. Upon a vacancy occurring in the membership of the Council the Lieutenant-Governor in Council may appoint a person to fill the vacancy and such appointment shall be for the remainder of the term for which his predecessor was appointed.
5.
  - (1) The Lieutenant-Governor in Council may name one of the members to be president of the Council for a period not exceeding the term of his appointment as a member.
  - (2) There shall be a vice-president elected annually by the Council from among its members.
  - (3) When the office of president is vacant, or in the absence of the president, the vice-president shall act as president.
  - (4) There shall be an executive committee consisting of the president and vice-president ex officio and three members elected annually by the Council from among its members, which shall have, when the Council is not in session, such powers of the Council as the Council delegates to the executive committee.
6. No member of the Council or of any committee thereof shall receive any remuneration for his services, but each member shall be paid his proper travelling and other expenses incurred in the work of the Council or the committee thereof.
7. At any meeting of the Council five members shall constitute a quorum.
8. A majority vote of the members present at any meeting of the Council shall determine any question.

"Council";  
"Minister"

Council,—  
establishment;  
objects.

Members,—  
term of  
appointment.

Vacancies.

President

Vice-  
President.

Vacancy in  
office of  
president.

Executive  
Committee.

Remuneration  
and expenses.

Quorum.

Majority.

9. The Council shall have power,—

Power of  
Council.

- (a) to take over and continue as the Council may determine, the activities, staff and advisory committees of the Ontario Research Commission, a commission appointed under The Public Inquiries Act;
- (b) to enquire into industrial, agricultural and other research and scientific activity in, or affecting the material development of, Ontario;
- (c) to organize and maintain advisory or other committees in the several fields of industrial, agricultural and other research and scientific activity, and such other committees as the Council deems advisable;
- (d) to advise the Lieutenant-Governor in Council with respect to such industrial, agricultural and other research and scientific activity and, without limiting the generality of the foregoing, with respect to research workers and scientists, facilities for research and scientific investigation, research organizations and agencies, research projects and programmes whether fundamental or applied, the integration and co-ordination of industrial, agricultural and other research and scientific activity, co-operation as between public and private, provincial and extra-provincial agencies, and the use of public funds in the encouragement and carrying out of such research and activity;
- (e) to arrange for others to carry out such specific or general research programmes as may be authorized by the Lieutenant-Governor in Council, and to supervise the same;
- (f) to publish and disseminate scientific and technical information;
- (g) to establish and administer scholarships to assist in the training of research and scientific workers;
- (h) to receive property, real or personal, or funds given to the Council for specific or general research purposes and to administer the same;
- (i) subject to the approval of the Lieutenant-Governor in Council to apply for or acquire patents of invention or interests therein, and to dispose thereof;
- (j) to make by-laws for the conduct of its business and for the control and direction of its work;
- (k) to do all such other things connected with industrial, agricultural and other research and scientific activity as may from time to time be authorized or directed by the Lieutenant-Governor in Council.

Rev. Stat.,  
c. 19.

10. There shall be paid out of the Consolidated Revenue Fund such sums as the Lieutenant-Governor in Council may authorize, for the following purposes:

Finances.

- (a) the administrative expenses of the Council;
- (b) the establishment and awarding of scholarships to assist in the training of research and scientific workers; and
- (c) contributions to the cost of such group industrial, agricultural and other research projects and activities as are recommended by the Council and are undertaken by industrial, agricultural or other organisations or groups on a basis on which the contribution from the Consolidated Revenue Fund does not exceed fifty per centum of the cost of the project or activity.

- |   |   |
|---|---|
| <p>§11. (1) The Council shall after the close of each fiscal year file with the Minister and with the Provincial Secretary an annual report which shall include a financial statement, a description of the work of the Council for the previous year and such other information as may be required by the Minister.</p> <p>(2) The Provincial Secretary shall submit the report to the Lieutenant-Governor in Council and shall then lay the report before the Assembly, if it is then in session, or if not, at the next ensuing session.</p> | <p>Annual report.</p>                               |
| <p>12. (1) The accounts of the Council shall be audited by the Provincial Auditor or by such other auditor as the Lieutenant-Governor in Council may appoint, and the Auditor shall make an annual report in respect of the preceding fiscal year to the Minister.</p> <p>(2) The Minister shall lay such report before the Assembly if it is then in session, or if it is not, at the next ensuing session.</p>  | <p>Tabling of report.</p>                           |
| <p>13. This Act shall come into force on the 1st day of April, 1948.</p>  | <p>Audit.</p>                                       |
| <p>14. This Act may be cited as THE RESEARCH COUNCIL ACT, 1948.</p>   | <p>Auditor's report to be laid before Assembly.</p> |
| <p>* As amended by "Statute Law Amendment Act, 1950," Bill No. 145, Sec. 23, Ref. Chapter 79, Sec. 20, (1) and (2).</p>   | <p>Commencement of Act.</p>                         |
|   | <p>Short title.</p>                                 |



# RESEARCH COUNCIL OF ONTARIO

## *Sixth Annual Report*

1953 - 1954



ONTARIO

TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON  
PRINTER TO THE QUEEN'S MOST EXCELLENT MAJESTY

Research Council of Ontario,  
39 Queen's Park Crescent,  
Toronto 5, Ontario.  
August 25, 1954.

The Honourable W. K. Warrender, Q.C.,  
Minister of Planning and Development.

Sir:

Herewith is the report of the Research Council of Ontario for the fiscal year April 1, 1953, to March 31, 1954. Because of the death in November 1953 of the Director, Professor J. O. Wilhelm, a summary and general report have been prepared by the Assistant Director, Mr. W. J. Mackey.

The eight reports of the advisory committees give some idea of the extent of the activities of the Council. In addition, the Council during the year has furthered closer co-operation between federal and Provincial research groups and assisted certain specialists from abroad to take part in the Council's committee meetings. Lastly the Council has carefully reviewed research activities in other countries in order to adopt the most approved methods of co-ordinating its research. Dr. Alexander King, Head of the Intelligence Division of the Department of Scientific and Industrial Research of the United Kingdom, spoke to the Council members on this subject. It appears that, if the Council is to be more effective in the future, it would be desirable to maintain a closer and more constant liaison between universities, government departments, industrial groups and, through the Provincial Cabinet, members of Parliament.

The accelerated pace in the application of scientific discoveries to physical and social problems throughout the world indicates that, if the Province of Ontario wishes to continue its leadership, more effort will have to be made in interpreting and applying newer scientific discoveries to our daily life.

Respectfully submitted,

R. K. Stratford,

President.

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### JOSEPH OSCAR WILHELM

It is with deep regret that the President and Members of the research Council of Ontario record the death of their Director, Joseph O. Wilhelm, on November 19th, 1953. Because of his zeal and enthusiasm the Council and its scientific committees have made an outstanding contribution to the effective co-ordination of research within the Province. Such benefits as he assisted in establishing will be a lasting memorial. His many friends will not forget how he worked for a better Canada.



## RESEARCH COUNCIL OF ONTARIO

R. K. STRATFORD, B.S.A., M.Sc., D.Sc., LL.D., F.C.I.C. (President)	Scientific Adviser, Imperial Oil Limited, Sarnia.
G. E. HALL, A.F.C., E.D., M.S.A., M.D., Ph.D., D.Sc., LL.D., D. ès Sc., F.R.S.C., (Vice- President)	President, University of Western Ontario, London.
G. P. GILMOUR, M.A., D.D., D.C.L., LL.D.	President, McMaster University, Hamilton.
E. HOLT GURNEY, LL.D. <sup>1</sup> - - - -	Chairman of the Board, Gurney Products Limited, Toronto.
HUGH LAWSON, B.Sc. - - - -	Vice-President, York Knitting Mills Lim- ited, Toronto.
W. A. MACKINTOSH, C.M.G., M.A., Ph.D., LL.D., D.C.L., F.R.S.C.	Principal, Queen's University, Kingston.
W. E. PHILLIPS, C.B.E., D.S.O., M.C., LL.D.	50 St. Clair Ave. W., Toronto.
G. N. RUHNKE, B.S.A., M.S.A., F.C.I.C., F.A.I.C.	Director of Research, Ontario Dept. of Agriculture, Guelph.
SIDNEY E. SMITH, Q.C., M.A., LL.B., D.C.L., LL.D., F.R.S.C.	President, University of Toronto, Toronto.
H. B. SPEAKMAN, B.Sc., M.Sc., D.Sc., LL.D., F.R.S.C.	Director, Ontario Research Foundation, Toronto.
K. F. TUPPER, O.B.E., B.A.Sc., S.M. <sup>2</sup> - - -	Dean, Faculty of Applied Science and Engineering, University of Toronto, Toronto.
H. M. TURNER, B.S., M.S. - - - -	President, Canadian General Electric Co. Limited, Toronto.

### Director:

J. O. WILHELM, O.B.E., B.Sc., M.A. <sup>3</sup> - -	Research Council of Ontario, Toronto.
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### Meetings:

May 12-13, 1953, Ottawa.  
Nov. 27-29, 1953, General Brock Hotel, Niagara Falls.  
Dec. 29, 1953, 39 Queen's Park, Toronto.  
March 11-12, 1954, Guild of All Arts, Scarboro.

### Executive:

DR. R. K. STRATFORD (President)	DR. G. E. HALL (Vice-President)
DR. E. HOLT GURNEY <sup>1</sup>	MR. HUGH LAWSON
DEAN K. F. TUPPER <sup>2</sup>	

### Meetings:

Oct. 1, 1953, 39 Queen's Park, Toronto.  
Nov. 27, 1953, General Brock Hotel, Niagara Falls.  
Dec. 18, 1953, 39 Queen's Park, Toronto.  
March 10, 1954, Guild of All Arts, Scarboro.  
March 26, 1954, Royal York Hotel, Toronto.

### Scholarship Committee:

DR. R. K. STRATFORD (Chairman)	DR. G. E. HALL
DR. G. P. GILMOUR	MR. HUGH LAWSON
DR. W. A. MACKINTOSH	PROF. G. N. RUHNKE
DR. SIDNEY E. SMITH	DEAN K. F. TUPPER <sup>2</sup>
DR. H. B. SPEAKMAN	J. O. WILHELM <sup>3</sup> (ex officio)

### Meetings:

April 15, 1953, 39 Queen's Park, Toronto.  
Nov. 27, 1953, General Brock Hotel, Niagara Falls.  
March 11, 1954, Guild of All Arts, Scarboro.

<sup>1</sup> Died March 19, 1954.

<sup>2</sup> Resigned March 31, 1954.

<sup>3</sup> Died Nov. 19, 1953.

Figure 1 — Budget, 1953-54

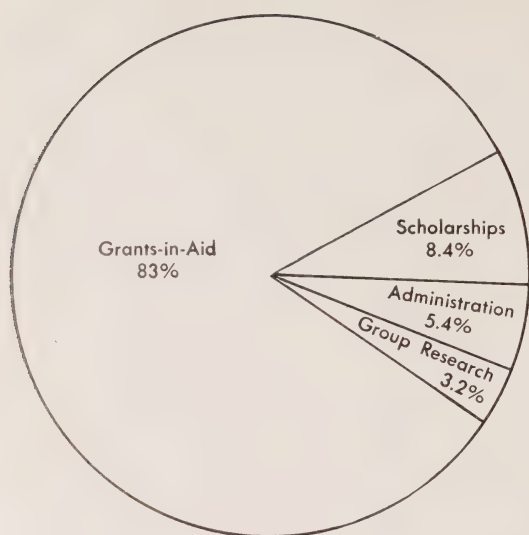


Figure 2 — Division of Grants-in-aid among Research Institutions, 1953-54

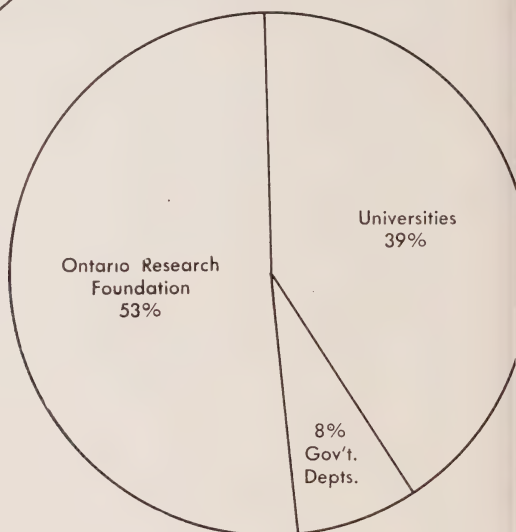
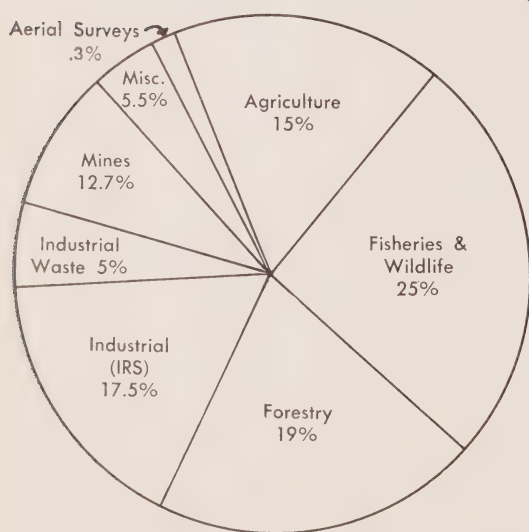


Figure 3 — Grants-in-aid by Committees, 1953-54



## SUMMARY AND GENERAL REPORT

The objective of the Research Council of Ontario, as stated in the Research Council Act of 1948, is "the betterment of industrial, agricultural and other research and scientific activity in Ontario as a means to the utilization of the resources of the Province". Two hundred and seventy industrialists, government officials, and university research scientists who serve voluntarily on the committees of the Research Council are aware of the Government's concern about changes which are affecting the Province. They believe that they have a responsibility in helping to define the problems which have been intensified by post-war development, and to recommend scientific inquiry wherever it may be needed to assist in the solution of these problems.

The activities of the eight advisory committees of the Research Council during 1953-54 are reviewed in this annual report by their chairmen. These reports indicate some of the problems which are considered of prior importance, and discuss related research effort which is receiving government support through the Research Council. The following statement is intended as a summary of the Council's work with respect to expenditures, co-operative research with industry, training of scientific personnel, and coordination of research.

### Grants in Aid of Research

It is not an aim of the Research Council of Ontario to support costly programs of continuing research. The Council's function is more specifically to coordinate government research effort in the Province, to assess needs, and to make recommendations on the broad features of public aid to scientific research and development. Nonetheless some comments on current expenditures of the Research Council will serve to illustrate the encouragement which its various committees are giving to scientific work which they believe to be in the public interest. The charts on page six show the allocation of Research Council funds in 1953-54.

By way of summary, grants in support of investigations in agriculture, fisheries, wildlife, and forestry totalled nearly \$300,000 out of a budget of \$490,000 for assisted research. (Details of the projects sponsored by all the committees are included in this Report as Appendix III.)

In the industrial field \$86,000 was used to help maintain the technical assistance which is provided to small manufacturers by Industrial Research Services, a department of the Ontario Research Foundation whose operations are of special interest to the Council's Industrial Research Committee.

To aid in controlling industrial waste \$26,000 was spent to assist the Ontario Research Foundation, which is the technical agent for the extensive study in pollution which the Research Council is conducting in co-operation with industry in the Sarnia area and elsewhere.

In mines and metallurgy \$62,000 was expended for research directed to advanced techniques of geological investigation, ore analysis, and metallurgical processing. This work has attracted international recognition. It has been difficult to continue some of the researches because of the demand from industry for the services of graduate students who are being trained in these techniques.

Expenditures, of course, are one measure of activity and results are another. Is the Research Council showing results from these operations? We believe that our industrialists as well as government and university scientists have no doubts about dividends. Their opinion is based on intimate knowledge of the needs in their special fields and what government funds are accomplishing through the committees of the Research Council.

Each of the advisory committees is conducting a program of research which will improve the quality and quantity of production in its related industries, or which will protect natural resources from unnecessary exploitation and reduce waste and pollution. A few examples of the projects supported last year will illustrate this:

In the field of agriculture, a study was begun to evaluate the effects of minor elements in the soil on the colour and keeping quality of apples. Already a significant correlation with the element boron is apparent. This can mean greatly increased values to the apple industry of Southern Ontario if the research can be continued and correct techniques established for the use of growers.

The Fisheries and Wildlife Committee is supporting a study of plankton and methods of collecting and measuring these minute forms of aquatic life. This research will increase our understanding of fish productivity for specific waters and under various conditions of temperature, plant life, and chemical content. Studies of this kind which enlarge our understanding of basic principles will save many times the cost of the research and result in positive advances in management.

One phase of the work of the Forestry Committee, that of the chemical utilization of wood, is now being applied in the field. An economical method for extracting essential oils from waste wood is being studied. Laboratory techniques have been well developed. These methods are now under study in conjunction with the woods operations of a co-operating paper company. A still for extracting the oils has been designed and built. Logging operations of the company have been arranged so that branches and tops will be removed at a central location. The costs of operating the still will be kept with a view to proving its worth in reducing the waste and fire hazard which now result from abandoned slash.

An important project on sewage treatment research is being conducted with the approval of the Industrial Waste Committee. This is to study the effects of industrial wastes (oils, phenols, cyanides, detergents, etc.) on current sewage treatment processes. With the increasing industrialization of



Ontario many municipalities are faced with the problem of handling organic wastes together with inorganic substances from local industries. Satisfactory techniques and the men with training to use them are both in short supply.

With the aid of a mass spectrometer which was purchased by the Research Council, techniques have been developed in one of our universities for precise analysis of rare minerals in Canadian ores—minerals such as gold, platinum, palladium, rhodium, and iridium. This work, encouraged by the Mines Committee of the Research Council, is nearing completion as far as government support is needed, and most of the information and trained personnel have been taken over by interested mining companies in Ontario.

Aerial photography is proving its worth in several fields, notably in geological surveys, forest inventories, soil classification, and highway engineering. The chief problems in aerial surveys are those of photographing to an accurate scale and providing maximum interpretability of the details photographed. The latter problem is under study by the Aerial Surveys Committee, where both stereoscopic viewers and "unsharp masking" techniques are being investigated. Success in this work will contribute substantially to three of our greatest industries. But the work is involved and highly technical and will need encouragement and an increase of the modest funds which are going to support it.

These projects represent the type of work to which assistance is given at Ontario universities and government departments. They do not include the larger volume of research—mainly of the applied kind—which the Council sponsors at the Ontario Research Foundation. Here investigations are continuing in metallurgy, farm products utilization, air pollution, climate and crops, and parasites in fish and wildlife. A very encouraging proportion of this research has already reached the pilot plant or even the production stage. With the help of funds provided through Council the Foundation is also bringing a considerable measure of technical aid to small establishments of all kinds in the Province. This is done through the field work of Industrial Research Services.

A total of ninety projects received assistance from the Research Council of Ontario last year. In addition to the value of the work itself these projects are training much-needed researchers and technicians. This is illustrated particularly by the research which the Council sponsored in Ontario universities last year, where the number of scientific assistants, mainly graduate students, was more than eighty.

### Group Research

The investigations which were supported last year in co-operation with industry were small in number, but the work was of country-wide interest. These projects — in silviculture, in industrial pollution, in supersonic wire-rope testing, and in electroplating — are discussed in the chairmen's

reports (pages 30, 41, 47, 38). Group research as it applies to industry, particularly to small establishments, has been a major concern of the Advisory Committee on Industrial Research. The Industrial Research Services of the Ontario Research Foundation have tried many times to organize group research among small manufacturers and processors such as canners, tanners, food processors, and metalworkers. To date any activity in these fields has been short-lived or has terminated when a particular problem has been successfully dealt with.

## Scholarships

Research Council of Ontario scholarships applicable to 1954-55 have been raised in value in order to keep them better aligned with the new rates of the National Research Council. Under the Provincial scholarship plan students entering the first year of post-graduate research may now receive \$900. To students with one year of research experience \$1,000 is offered, and in subsequent years \$1,200. The schedule therefore continues to pay slightly more than the National Research Council rate for those just entering graduate studies, though somewhat less in the case of more advanced students. This is an inducement to engineers and science students to remain in university at least a year beyond graduation and perhaps to commence a career in research. Because of the increased rates in effect for this year only 51 scholarships could be awarded. The average for previous years was more than 60.

All who are familiar with this Provincial scholarship scheme are impressed by its importance. Only the most promising graduates are selected and all of these are of outstanding scholastic attainment. A growing technical potential in Ontario is resulting from the perennial flow of these trained researchers into industry, government departments, and educational institutions.

## Coordination and Planning

Research coordination is effected within specific areas by the recurring reviews made by the advisory committees. With respect to the Agricultural Committee, for example, members of both federal and Provincial Departments of Agriculture are represented, along with university research scientists and members of industry and agricultural organizations. To assist the Committee in special technical aspects there are now six sub-committees. These are in agricultural economics, agricultural engineering, soils, food processing, crops, and farm animals. The last two were organized during 1953-54. No one knows better than research people the adverse effects on scientific work of over-organization and the necessity of attending too many meetings. These new groups, however, have been set up in the belief that within their fields of interest important researches can be conducted or the problems more clearly delineated. There appears to be no

better way to deal with complex issues than the frank exchange of opinion among those who are best informed and most intimately concerned.

In a similar way the Advisory Committee on Forestry Research has been successful in drawing together the varied interests of federal and Provincial government departments, the universities and the forest industries in such specific areas as wood chemistry, forest biology, and sawmilling practice. Cutting across these special research fields, this Committee has also approached integration of research in a geographical sense. Its group on Forest Research in Northwestern Ontario is developing on a regional basis a pattern of industrial co-operation which may be of importance to research planning in other forest areas.

In ways peculiar to each, coordination of research is evident in the work of all the advisory committees. It is the hope of the Research Council that, as conditions permit, a much clearer picture of needs within their various fields will develop.

## **Federal Research**

To experiment on closer relationship between federal and Provincial research agencies, the Research Council visited the laboratories of several government departments at Ottawa in May, 1953. The work of the various federal divisions was clearly explained and freely discussed by those in charge. This meeting was followed by a visit to Ottawa in October by the main body of the Agricultural Committee, and frank discussions were held on one aspect in particular: the problem of ensuring the widest use of research by the producers and processors in the field of agriculture. The President has encouraged the advisory committees to meet from time to time with those engaged in similar fields in the federal departments. He has urged that the extensive research of the federal government be utilized as fully as possible by the Province.

## **Distinguished Visitors**

To benefit from the research experience of other countries the Research Council last year arranged for visits from three distinguished British scientists. In September Mr. W. R. Day, of the Imperial Forestry Institute, Oxford University, gave an illustrated talk before the Forestry Committee at the Forest Pathology Laboratory, Maple, and also lectured several times to forestry and agricultural students at the University of Toronto. His views on forest growth are based on many years of research at Oxford and bear direct significance to the problem of reforestation and related land use in Southern Ontario.

In agricultural meteorology an eminent authority from the Rothamsted Experiment Station in England, Dr. H. L. Penman, devoted some time to a study of current practices in Ontario and to an assessment of the need for research in climatology. In September he gave a talk before the Soils group



of the Advisory Committee on Agricultural Research, and subsequent to his visit prepared a report of his observations and recommendations.

Another visitor, Mr. Alexander King of the Department of Scientific and Industrial Research of Great Britain, kindly stopped off in Toronto in March while en route to Washington to speak to the Research Council on the government organization of scientific research in the United Kingdom. Mr. King highlighted four aspects of government research in Great Britain which reflect the public's awareness of the need and the general appreciation throughout Britain of research as an aid to improved conditions. First, the government has agreed to allow any surplus of research funds in one year to be carried over to the next year. Second, the government permits the Department of Scientific and Industrial Research to transfer money from one project to another during the year. Third, and most important, the government has adopted a five-year budget for research. Both parties of the House have agreed to respect the five-year budget except in the event of a national emergency. The budgets adopted to date are on an increasing scale which is permitting an expansion of new building as well as the increase of scientific staff at the rate of 120 people a year. Finally, the Treasury Department has agreed that the Department of Scientific and Industrial Research should not be looked upon as an ordinary department of government, but as a department for investment.

## Meetings of Council

During the year members of the Council met five times. In May they were guests of the National Research Council, the Dominion Department of Agriculture, and the Department (then) of Resources and Development in Ottawa. Discussions were held with federal research officers and visits were paid to the main government laboratories in and near the capital.

In November at Niagara Falls the Council met to consider the budget for 1954-55 and to review the next year's program of the advisory committees. The meeting was favoured by visits from the Minister of Planning and Development, Mr. W. K. Warrender, and Col. L. R. McDonald, then Deputy Prime Minister.

A special meeting of Council was held in Toronto on December 29 to consider the Minister's request that thought be given to a possible re-organization of Council. A reply, setting forth the opinions of Council on some aspects of the suggested change, was prepared and transmitted to the Minister.

In Scarboro on March 11-12 the spring meeting of the Research Council was held for a final review of projects for 1954-55. Grants in aid totalling about \$500,000 were approved subject to cuts, if necessary, to bring the total within the anticipated budget of \$490,000. Additional



miscellaneous projects totalling some \$33,000 were referred to a special committee, since these projects did not fall clearly within the responsibility of any of the advisory committees. At this meeting the usual yearly reports of the chairmen of the eight advisory committees were presented and discussed.

The final meeting of Council for the year was held in Toronto for the purpose of hearing Mr. Alexander King speak on research as it is organized and conducted by the Department of Scientific and Industrial Research of Great Britain.

The Executive Committee of Council met five times. In October a recommendation was prepared for research expenditures in Ontario over the next two years. In December a schedule was drawn up to provide closer liaison between the Council and the advisory committees. This was later put into effect when members of Council attended meetings of the committees which gave final review to requests for grants. The problem of obtaining a new Director to replace the late J. O. Wilhelm was also considered by the Executive.

The Scholarship Committee met twice in the year. At its main meeting in March, 155 applications were reviewed. From these, 51 awards were made within the limits of the statutory grant of \$50,000.

## ADVISORY COMMITTEE ON AERIAL SURVEY RESEARCH

**Chairman: Prof. K. B. Jackson**

Research has continued this year in photogrammetry on the observational techniques for the improvement of the interpretability of aerial photographs. A magnifying stereoscope has been adapted for the examination and measurement of prints or transparencies with means of obtaining and maintaining correct relative orientation of the photographs while scanning the whole area of the overlap.

Work on photographic techniques has not yet been completed, but some study has been made of the increase in resolving power available by making prints or diapositives with "unsharp masks" to control regional contrast while increasing detail contrast.

The development of an airborne navigational aid for maintaining correct lateral overlap in photography from long adjacent flight lines over unmapped territory is under investigation in cooperation with the Photographic Survey Corporation Ltd.

The problem of personnel and equipment is still acute and further efforts are being made to obtain the equipment necessary to develop post-graduate work in photogrammetry. In the meantime qualified personnel are being sought to assist in the completion of the work in hand.

## ADVISORY COMMITTEE ON AGRICULTURAL RESEARCH

Chairman: Prof. G. N. Ruhnke

Two two-day meetings of the Main Committee were held during the year. The first, at Guelph on May 21-22, 1953, was a joint meeting with the Advisory Committee on Forestry Research. The second, at Ottawa, was a two-day conference on Oct. 14-15, 1953 with officials of The Canada Department of Agriculture, when representatives of the Experimental Farms Service, Science Service, Production Service (Animal Pathology Division), and Marketing Service (Economics Division), were present and took part in the discussions. Dr. R. K. Stratford, President of the Council, was an interested visitor and active participant in both of the agricultural meetings.

The joint meeting of the Agriculture and Forestry Committees provided a needed opportunity for co-ordination of ideas on basic problems of soil and land classification, land use, and soil and water conservation; reforestation, and farm woodlot management also came in for their share of attention. On the second day the two committees and their visitors were taken on a tour of the Soil Erosion Experiment Station, at the Ontario Agricultural College. They also visited the contour-cultivated strip-cropped farm of Prof. H. A. Smallfield, the Shand Dam near Fergus, and the soil and crop experimental plots at the Soils and Agricultural Engineering Farm just east of the College. The field tour served to illustrate many of the problems raised in the discussions of the meetings.

The October conference with the agricultural research workers in Ottawa was primarily devoted to the subject "How can better use be made of the agricultural research that is now being done?"

Dr. Stratford very ably presented this question, and its implications, before the conference. He said he was convinced that excellent work in agricultural research is being done in the Province by both federal and Provincial organizations,—far better and far more work than is being fully utilized. He suggested that there was, however, need for "development" and pilot plant work analogous to that used so effectively in industry to bring the results of basic research rapidly into application in production.

The first day was then given over to a review of the organization and research programs currently under way in the federal units.

On the second day, further consideration was given to the main theme of the conference. The need for bridging the gap between the research effort and extension education at the farm level was recognized by most of those taking part in the discussion. While no definite recommendations for future action resulted, the following points met with general agreement:

(1) The problem of translating fundamental research in agriculture into applied research, and finally, into extension teaching, is a very complex one.



Photo—Ontario Agricultural College.

Second year growth of Leon red clover grown under photoperiods of 18, 16, 15 and 14 hours, left to right respectively. From study of physiology of clovers in artificially illuminated growth chambers, Department of Botany, Ontario Agricultural College.



Photo—Horticultural Products Laboratory, Vineland.

Some of the equipment used in research on making new fruit beverages in the Horticultural Products laboratory, Vineland Experiment Station.



(2) The federal Department of Agriculture, although not primarily concerned with the responsibility for extension service (which is recognized as a provincial function), has been forced by public demand to give a measure of extension service in connection with its field investigations on plant protection, pathology, etc.

(3) No major problems in Ontario agriculture at present are being neglected by either federal or Provincial research programs. The Provincial agricultural extension service is recognized as an important medium to bring farmers' problems to the attention of the research agencies.

(4) Agricultural extension workers in Ontario, in some cases, have been doing what is essentially "development" work (which would not have been done otherwise) because research people were not able to do the necessary "follow through" into the field.

(5) The twenty Illustration Stations, already established in Ontario by the Experimental Farms Service, were recognized potential as "pilot" plants and "development" stations.

At each of these stations, located on typical farms (under 3-year co-operative agreement with the owner), a resident agronomist is in charge and the farm program and operations are under his direction. The agronomist also provides information to the farmers in the surrounding area.

The general opinion was that more of such stations could be effectively located in Ontario, perhaps under joint federal-Provincial support and administration.

(6) Research in the field of veterinary science is well co-ordinated in Canada. An annual conference of all workers across Canada is held to discuss research programs under way in the federal Animal Pathology Division, branch laboratories, and at the veterinary colleges. It was emphasized that there is a lack of adequately trained research workers in veterinary science, and the question was raised as to whether scholarships could be provided for the encouragement of promising young men to enter this field; especially whether it would be of advantage to have some men provided with funds to study abroad in some of the older colleges of veterinary science.

(7) General approval was expressed by the federal representatives for the opportunity to discuss problems of mutual interest with Provincial research representatives and it is hoped that a similar meeting might be held at the Ontario Agricultural College, or some other suitable Provincial centre, where further consideration can be given to these matters.

In addition to the meetings of the Main Committee, there have been meetings of the sub-committees established last year, and of the two most recently organized Sub-Committees, on Farm Animals, and on Crops.

The **Sub-Committee on Agricultural Economics** met in November, 1953, to review the field of agricultural economic research and the adequacy

of the existing program. A report on the study of the economics of forage harvesting machines was given, and it was agreed that out of this work there should be a follow-up study of the forage harvester as a multi-purpose machine on Ontario farms.

A progress report was presented on the project on feed grain sources and costs at various country points across Ontario. The investigations so far revealed that the bulk of grain being handled was of western origin. Some dealers adopted a policy whereby they refused to handle Ontario-grown grain at all. Dr. Patterson, in whose branch the study is being made, reported that all available secondary data was being assembled and the field investigation is determining some of the methods by which home grown and western grain moves. The Federation of Agriculture, at its annual meeting, passed a resolution commending the Research Council for providing funds to make this study possible. It is expected that, ultimately, a published report on the subject will be issued by the Ontario Department of Agriculture.

The Sub-Committee reviewed a number of other economic problems and set up a tentative listing of these in order of priority for future study. Two of these were selected for recommendation to the Council for support for 1954-55; these were *The implications of freight rate changes in the last two or three years*, and *Some factors involved in the cost of production and marketing of fruit*. Both problems were considered by Sub-Committee and by the Federation of Agriculture to be worthy of immediate study.

**The Sub-Committee on Food Processing** met three times during the past year. The first meeting was largely devoted to a review of existing Council-supported projects in this field and a consideration of the terms of reference and scope of future activities of the Sub-Committee.

The second meeting was occupied with reviewing in some detail reports of the work on *Freeze Concentration of Apple Juice* (Dr. M. D. Smith, U. of T.); *Fruit Juice Research* (Dr. J. H. L. Truscott, Hort. Products Research Lab., Vineland); *Utilization of Whey for Production of Lactic Acid and Calcium Lactate* (Mr. Campbell, Ontario Research Foundation); and *Storage Rot of Celery* (Dr. J. H. L. Truscott, Vineland). All of these projects were supported by Council grants-in-aid during the past year.

The third meeting resulted in the election of Dr. W. D. McFarlane as chairman and Mr. Lorne Campbell as secretary of the Sub-Committee. Enlargement of the membership was also decided upon. Prof. L. R. Bryant of the O.A.C. Chemistry Department was named to represent the field of dairy products processing. It was proposed, also, that representation should be invited from Defence Research Board's Nutrition Research Division.

The requested support from the Council for Fruit Juice Research (\$5,000.) at the Horticultural Products Laboratory at Vineland for a second year was approved. So also was the application for a further grant-

in-aid (\$800.) for another year for the investigation of celery rot at the same laboratory.

Problems of centralized refrigeration, of the production of protein by iron bacteria, and the use of ultra sonics and nuclear radiation in food preservation are to be discussed at future meetings.

**The Sub-Committee on Agricultural Engineering** held but one meeting, (April, 1953) during the year. This Sub-Committee, created to review the status of research in the general field of engineering on the farm, and more particularly problems in relation to farm machinery, farm structures, and safety, has not yet selected its own executive officers.

At its initial meeting, however, it was revealed that most members were of the opinion that the national agricultural engineering committee already established, and participation of the bulk of the members in it and in the American Society of Agricultural Engineers, insured complete and effective communication amongst researchers in this field and that there was not any urgent and immediate task for the Committee to undertake.

A second meeting was proposed for the autumn of 1953, and an invitation extended to the committee to meet at the Central Experimental Farm. Various circumstances combined to prevent this from materializing at the time. For these reasons the Committee has not been called together, awaiting a more opportune time when problems of common interest would arise and justify a formal meeting.

**The Sub-Committee on Soils** held a meeting on September 16, 1953, at which they had as guest speaker and consultant, Dr. H. L. Penman of Rothamsted Experimental Station, England. The subject of primary interest and discussion was that of agro-meteorology and the need for additional research in that field.

The work being done by the Research Foundation on water losses by evaporation from the soil; at the Ontario Agricultural College Hydrology Station on losses by run-off; and at Ottawa in the Divisions of Field Husbandry, Soils and Agricultural Engineering on soil-crop-moisture relationships, were all reviewed as a prelude to Dr. Penman's talk, which outlined the most recent concepts of the fundamental nature of these problems.

A report of Dr. Penman's observations and conclusions based on his short visit to Ontario has been received by the Council and has been circulated among the members.

**The Sub-Committee on Farm Animals** held its first meeting on March 5, 1954. The personnel of this committee has been carefully selected to be representative of those persons familiar with the federal and Provincial research programs relating to all classes of farm livestock, and to poultry. The areas to be covered by this Sub-Committee are those of health, nutrition, management, and breeding of livestock and poultry. Dr. H. D.



Branion, Head, Department of Nutrition, O.A.C., has been elected chairman, and Dr. J. C. Rennie, Associate Professor, Animal Husbandry Dept., O.A.C., secretary.

Only one application for a grant-in-aid for research was referred to and approved by the Sub-Committee, viz, that of Dr. A. A. Kingscote, for \$1,000. for assistance for research on trichinosis. The project has been approved by the International Conference on Trichinosis and also commended by the chief of the federal Animal Pathology Division of Production Service.

The latest sub-committee to be established is that on crops. The area to be covered by this committee includes the production, quality, plant nutrition, plant protection, breeding and genetics of field, garden, and orchard crops.

The personnel of the committee includes representation from federal divisions of both Experimental Farms Service and Science Service. Specialists in agronomy, horticulture, pathology, and physiology, who are responsible for research directly relating to crops, form the majority membership. These people, by reason of their positions and their membership on a number of Department of Agriculture committees, are thoroughly conversant with the problems in the crop production field. The chairman of this Sub-Committee is Dr. D. N. Huntley, Head, Department of Field Husbandry, O.A.C., and the Secretary, Mr. A. H. Martin, Director, Crops, Seeds and Weeds Branch, Ontario Department of Agriculture, Toronto.

At the first meeting lists of the presently active research projects in Ontario were distributed to the members to assist the committee in its work of surveying the program as it now exists, and assessing its adequacy in relation to future probable needs. A list of the projects relating to crops for which grants-in-aid have been requested from the Council was also distributed, but time did not permit a detailed review of each project. The committee were agreed, however, that the recommendation of the Chairman of the Main Committee should be acceptable to the Council.

Out of the general discussion regarding the status of crops research came a most interesting point of agreement, viz, the recognized urgent need for more work on agro-meteorology and climatology in relation to crop adaptation, incidence of pests and diseases of plants, etc. A special brief is being prepared embracing a recommendation for future work in this field.

Now that the proposed organization of the committees on agricultural research has been completed, it remains to be seen how far the suggested terms of reference for advisory committees will be effectively carried out. Certainly, we have now a means for more adequately exploring the status of agricultural research in the Province, and for indicating those areas in which strengthening would be desirable. This is not a simple task. It will require time to make the necessary surveys and assessments from which ultimately the desired recommendations may come to the Council relative to longer term trends and needs for the future in agricultural research.



## Agricultural Research Program for 1954-55

Twenty applications for grants-in-aid for research projects in agriculture were received for the new fiscal year. These cover work proposed to be done in each of the following institutions and departments: Ontario Research Foundation (Farm Products Utilization, Climatology); University of Toronto (Geography, Botany, Biochemistry); McMaster University (Botany, Bacteriology); University of Western Ontario (Botany); Ontario Agricultural College (Horticulture, Field Husbandry, Agricultural Economics, Botany, Zoology); Ontario Veterinary College (Parasitology); Farm Economics Branch, Ontario Department of Agriculture; Horticultural Products Laboratory, Vineland.

Total funds requested for the above applications were \$76,140. Total allocation of funds for projects classified under Agriculture in 1953-54, was \$81,840.



# ADVISORY COMMITTEE ON FISHERIES AND WILDLIFE RESEARCH

Chairman: Dr. J. R. Dymond

The Committee held two meetings and the Executive two additional meetings during the year.

One of the means adopted by the Committee to survey and assess the research related to fisheries and wildlife being carried on in the Province is through the holding of a Technical Session at which papers presenting the results of research are presented. These sessions rotate among the four Universities of the Province where research supported by the Council is being carried on. This year the Eighth of these sessions was held at Queen's University on February 26th and 27th. These Technical Sessions contribute to the promotion of research and its application

- (1) by requiring that the results of research be organized and presented for criticism;
- (2) by providing a stimulus for improving the quality of research through the comparison of the quality of research carried on by different individuals and institutions;
- (3) through the exchange of information;
- (4) by providing those engaged in application with the latest research results and those engaged in research with the stimulus from the prospect of seeing their results applied.

Besides providing an opportunity for surveying and assessing the research being carried on in the Province, the Technical Sessions further the integration and co-ordination of research. The extent to which this is done is indicated by affiliations of those attending the meetings. Of 86 who signed the register last year (total attendance was approximately 100), more than half (48) represented the four Ontario Universities, the Ontario Research Foundation and the Royal Ontario Museum of Zoology, (29 staff and 19 students). Twenty-one were from the Ontario Department of Lands and Forests (14 headquarters and 7 field staff); 8 the Federal Government (4 Entomology, 3 Wildlife, 1 Plant Pathology). The remainder (9) represented the Ontario Department of Planning and Development, the Ontario Agricultural College, the Research Council of Ontario, the Conservation Council of Ontario, and Cornell University.

Included in the 25 papers presented, besides those on research supported by the Advisory Committee on Fisheries and Wildlife, were one supported by the Forestry Committee and one by the Committee on Agriculture. At least one of the papers concerned pollution. While few of the papers dealt with problems of immediate practical application, many contributed information of value in management, dealing with such problems

as soils, water fertilization, age structure of wildlife populations, fish migration, food habit studies, pollution, occurrence and distribution of flies of medical importance, indicators of suitable habitats for game fish in streams, and parasites and diseases of fish and wildlife.

The value of the Council's grants in contributing to the training of students in research was emphasized in my report to the Council last year. The statistics will not be repeated now, but in assessing the value of the work carried out under the auspices of the Committee on Fisheries and Wildlife, it should be remembered that students who have received research training under this Committee are now employed not only on fisheries and wildlife in provincial and federal organizations but also in forest entomology, agriculture, defence and health as well as in universities and other scientific institutions. Seventy-one per cent are engaged in other than fish and wildlife work.

In line with the President's suggestion that advisory committees consider means for furthering the application of research results to the better management of our resources, the Fisheries and Wildlife Committee has emphasized this problem in its deliberations this year.

The trend towards more soundly based regulations and procedures in the management of our fisheries and wildlife resources which has been gathering momentum for several years was very noticeably hastened during the past year, culminating in the announcement by the Minister of Lands and Forests of a ten-year program for improving the management of these resources.

This trend has been brought about largely by 1. placing in charge of the administration of these resources men with scientific training as well as administrative ability; 2. the accumulating body of scientific knowledge based on the results of research; 3. education of the public through the employment of district biologists and in a variety of other ways.

Three examples of increased research or of the applications of the results of research are:

- (1) The initiation of a Great Lakes program in which the Federal Fisheries Research Board is co-operating with the Ontario Department of Lands and Forests. For the present efforts will be confined largely to an attempt to prevent the increase of the marine lamprey in Lake Superior. If the methods to be tested there prove successful they will be extended to Lake Huron in an attempt to reduce the lamprey population there. Later research will be extended to other species and to other lakes.
- (2) The ten-year program recently announced by the Minister of Lands and Forests in which it is proposed to give commercial fishing greater scope for the removal of coarse fish, provided game fish are properly protected. A study carried out in South Bay, Manitoulin Island, in which fishing pressure greatly in excess of



that exerted by commercial fishing failed to show any recognizable detrimental effect on the populations of bass or lake trout, gave clear evidence of the destructiveness of the lamprey in reducing lake trout.

- (3) A study of deer carried out by the Research Division of the Department of Lands and Forests in Northwestern Ontario. The popular belief that a decline in the deer population was due to overhunting led to a demand that deer hunting be restricted particularly by non-residents. This would have resulted in considerable economic loss to tourist operators and in license fees to the Department. This loss was prevented when the Department's studies showed that weather and food and not hunting had been responsible for the decline.

Further improvement in the management of fisheries and wildlife require a strengthening of all three of these factors. No one or two of them without the other can be effective in securing the best results.

Adequate information based on the results of research will not guarantee success unless the administrative staff is adequate in numbers and competent to use the scientific knowledge. Even an adequate and competent staff in possession of all the scientific information necessary cannot effectively administer the wisest of regulations and the best possible management techniques if the public believe in the wrong techniques and insist on unwise regulations.

We are far from having enough scientifically trained men engaged in administration although an excellent start has been made in recruiting men of high scientific attainments and of excellent administrative ability. We are also far from having adequate scientific knowledge soundly based on the results of research. Increased research both fundamental and applied is urgently needed.

Inadequate as are the administrative and research staffs, perhaps the greatest bar to improvement in fisheries and wildlife administration is the lack of public education with respect to sound principles of fisheries and wildlife management. In the opinion of those who have devoted the most study to the subject the public is compelling the Government to waste money and effort on unproductive management techniques. Two of these are the planting of most of the fish raised in hatcheries under conditions where they make no worthwhile return to the angler or commercial fisherman, and the payment of bounties for the destruction of predators.

The education of the public so that they will cease demanding unwise procedures and insist on management in line with the most up-to-date knowledge presents many difficulties. One of the deficiencies that must be remedied before public education in fisheries and wildlife management can be effective is in the provision of suitable literature.

Information on the place of hatcheries in maintaining fish populations may be cited as an example of the need and of the difficulties involved in public education. Facts derived from the results of research not only in different parts of this country by different agencies but in other countries, and extending over many years, have never been brought together, organized, interpreted and presented in a form suitable for use by district biologists, anglers and commercial fishermen and other interested members of the public. There are two reasons for the failure to bring together and interpret such material. First, such work has not rated highly as scientific contribution and second, at least in this country, only a comparatively few people have the necessary technical background, and they have been too busy with other pressing duties.

However, the Advisory Committee on Fisheries and Wildlife regard the matter as so important that they have undertaken to try to make a start at preparing a review of literature on some subject of importance in fisheries or wildlife and have placed in the estimates which they have recommended to Council a small sum for the payment of some of the expenses involved in such a project.

The provision of reviews of the results of research is part of a much greater problem to which the Committee is giving attention. That is the problem of enabling research workers and other scientists to learn what has been discovered as a result of research about any subject on which they wish to obtain complete and up-to-date knowledge. It is said that more than a million scientific or technical articles are published each year in about fifty thousand journals. The unaided individual worker cannot possibly hope to keep abreast of all or even most of the knowledge accumulating as a result of research.

As a result of grants made to the Department of Zoology, University of Toronto, there has been organized and indexed a great deal of the literature in freshwater biology. This is now accessible not only to workers in Toronto but workers anywhere in Canada. An experiment in the co-operative indexing of literature in aquatic biology, both freshwater and marine, has now been organized, including the biological stations of the Fisheries Research Board of Canada and research organizations in other provinces. The support given by the Research Council of Ontario has played an important part in making this possible.

# ADVISORY COMMITTEE ON FORESTRY RESEARCH

Chairman: Dean J. W. B. Sisam

## Sources of Raw Material for the Pulp and Paper Industry

At a 1953 meeting of the Research Council, when the work of the Advisory Committee on Forestry was under review, a question was raised as to the feasibility of reclaiming and re-constituting waste paper to assist in meeting future paper requirements. From the information obtained, mainly through the Pulp and Paper Research Institute of Canada, it appears that a fairly high percentage of available waste paper is now being used, particularly in the manufacture of paper box stock, and that there is little likelihood of there being much increase in the use of this material in the future. Three problems that limit the use of waste paper are: (a) collection and handling; (b) the de-inking of newsprint and magazine papers; and (c) the weakening of the fibre structure by further chemical processing.

It is relevant to the work of the Advisory Committee to mention here the general situation with respect to sources of raw material for the pulp and paper industry. There are a number of materials, apart from wood, such as straw and bagasse (sugar-cane waste), which periodically receive attention in the popular press, sometimes with the suggestion that they may increase greatly in importance as raw materials for the industry. However wood is generally considered to be preferable, and at the present time constitutes well over 90 percent of the material used in world pulp production<sup>1</sup>. As long as wood is in good supply and at a comparable cost, it will undoubtedly be the choice of the industry.

However, having in mind all such sources of raw material and the development of new sources of pulpwood, as in the southern United States, one must recognize that the competitive position of the pulp and paper industry in Ontario in the future will be determined to a considerable extent by the presence of high volumes per acre of good quality wood within reasonable distances of the market (mills). Among the more important matters affecting this situation are (a) provision for re-establishing the forest as mature stands are cut (regeneration), and (b) adequate protection of the forest against fire, insects, and disease.

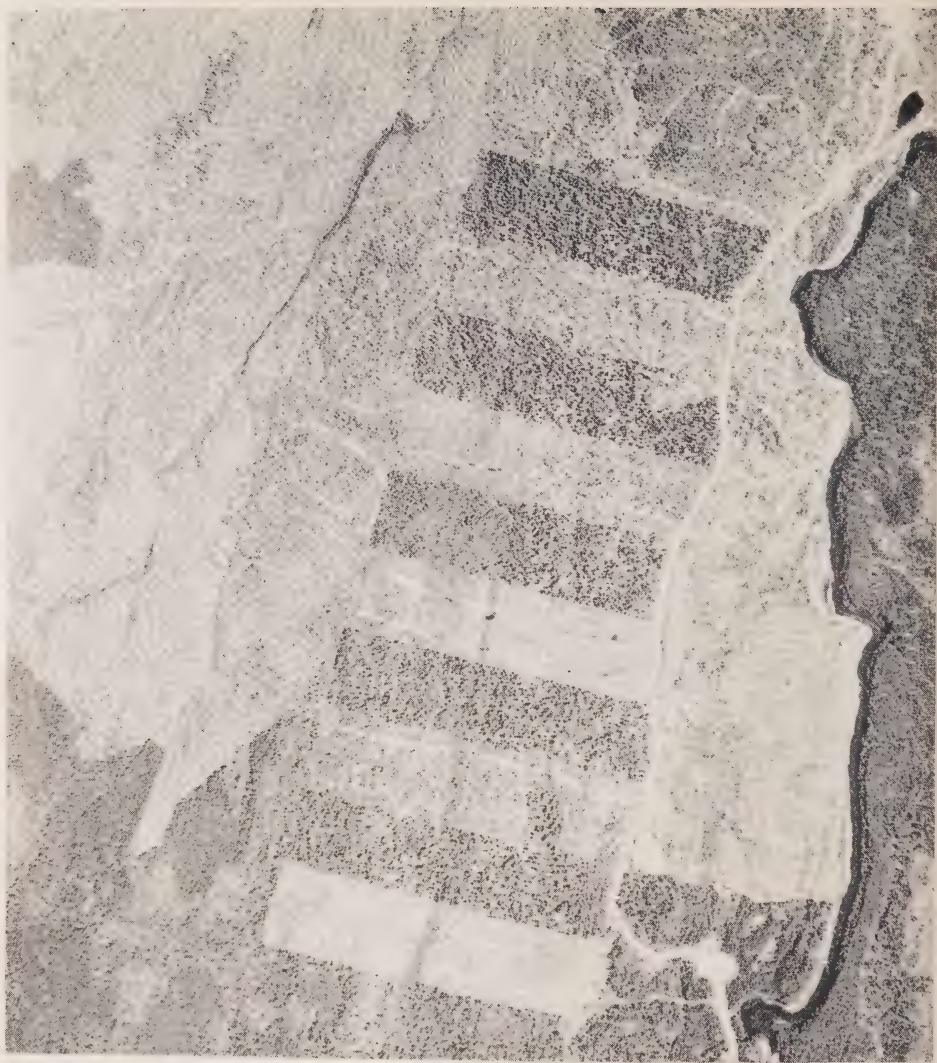
## Regeneration and the "White Paper"

Recently the Department of Lands and Forests prepared a statement of forest policy (so-called "White Paper"<sup>2</sup>) for the consideration of the Provincial Legislature. It is interesting to note in this paper a reference

<sup>1</sup> See "Raw Materials for More Paper" FAO Forest Products Study No. 6, Food and Agricultural Organization of the United Nations, Rome, Italy. 1953. pp. 172.

<sup>2</sup> "Suggestions for program of renewable resources development 1954", Ontario Department of Lands and Forests mimeo. pp. 43+ appendices.





Photo—Spartan Air Services Limited, Ottawa.

ABOVE: Aerial view of experimental forest plots adjacent to the Black River north of Heron Bay, Ontario. This five-year project in Silvicultural research is financed jointly with two pulp and paper companies (see p. 30). The rectangular test area comprises nearly 400 acres. Seeding and regrowth of white spruce will be studied in relation to various kinds of logging and regenerative aids.



RIGHT: Members of participating groups examine plots in the second year of the experiment.



to the present unfavourable situation with respect to the red and white pine lumber industry in this Province and the reasons therefore, these being (1) too rapid a removal of the virgin stands; (2) lack of regeneration on any adequate scale after logging; and (3) lack of adequate protection of the growing forests from various destructive agencies. It is further pointed out that a similar situation of declining supplies of quality material for the pulp and paper industry may soon develop unless corrective action is taken.

With regard to regeneration, the government has now set down its policy in the "White Paper" by stating that "All forest operators on Crown lands will be required to follow silvicultural practices which will quickly assure full stocking of the medium and better sites of all cut-over lands."

That this policy and the legislation (recent amendment of the Crown Timber Act) intended to implement it may raise some difficulties should be apparent from the survey of regeneration conditions in the Province, made by Professor R. C. Hosie with the support of the Research Council, the results of which have been published during the past year<sup>1</sup>. Briefly these indicate that while regeneration is generally adequate over extensive areas of unburned cut-over land, particularly on the poorer growing sites, it is inferior in quality to the original stand—that is there is a relatively higher proportion of the less valuable species—and that regeneration is inadequate on about 20 percent of the cut-over area representing usually the better growing sites.

In the past studies have been undertaken in connection with regeneration and other aspects of forest management by both government and industrial organizations. However, these projects have usually been on a small scale and often with little co-operation between the different groups concerned. In order to help overcome these deficiencies certain projects have been initiated during the past year largely as a result of recommendations of the Advisory Committee on Forestry and with the support of the Research Council. While some reference has been made to these projects in earlier reports, they were actually started only in 1953.

### Co-ordination of Research

To begin with, it was suggested that research in Ontario should be organized on a regional basis in order to provide a relatively uniform background for study and interpretation, and to develop the maximum co-operation among those engaged in forestry research, whether in the employ of government or industry. A start has been made in one such region—that of northwestern Ontario—and during the year three projects got under way.

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<sup>1</sup> Hosie, R. C. "Forest Regeneration in Ontario", University of Toronto Forestry Bulletin No. 2, University of Toronto Press, Toronto, 1953, pp. 134.

**(a) Co-ordinating Research Committee:—**

The committee set up to stimulate interest and improve co-operation in research activities in northwestern Ontario and whose origin was referred to in the report for 1952-53, began its work during the past year, and has already proved its value. To facilitate and support the work of this committee an information centre and library service have been established, and a librarian has been appointed. Detailed reports on these activities are available.

**(b) White spruce regeneration project RC-17:—**

For the purpose of studying problems affecting the regeneration of white spruce on typical sites of the pulpwood forest of the region, a group research project has been set up involving the support of the Ontario Paper Company, the Abitibi Power and Paper Company, and the Government of Ontario. It is believed that other companies may become interested in supporting this program as the work progresses. Reports are available giving details of the work completed to date and a statement of the costs involved. In the planning and carrying out of this project there are associated the representatives of the two companies named above, the Provincial Department of Lands and Forests, the Pulp and Paper Research Institute of Canada, the federal Forestry Branch, and the Faculty of Forestry, University of Toronto.

**(c) Productivity study:—**

One other project relating to forest management in this region that has been carried on with the support of the Council and might be mentioned here is the study of the relative productivity of three physiographic sites in the northern black spruce forest. Support was given for a graduate student to undertake this study under the direction of Professor T. W. Dwight of the Faculty of Forestry. The work has been completed, and the results incorporated in a thesis, which the student presented in partial fulfilment of the requirements for his degree.

**Plantation Forests in Southern Ontario**

Having in mind accessibility, a relatively long growing season, and the fact that there is a considerable area of land that can best be used for the growing of tree crops, there would seem to be ample justification for an extensive afforestation program in southern and south central Ontario, to provide for the future needs of the wood-using industries in this part of the Province, as well as assisting in the protection of soil and water values and in developing recreational facilities near the larger centres of population. Such a program has been under way for some time, and according to the "White Paper" referred to above, a considerable expansion of this work is contemplated in the near future.

There are many problems involved in the success of such a project, and at the present time an integrated program of research covering many of these is being developed. This involves support by the Research Council and co-operation among a number of agencies. The following matters relating to this program are of direct concern to the Research Council.

**(a) Soil Microbiology:—**

The importance of fungi in bringing about soil conditions favourable to the growth of trees is not as clearly understood as their destructive activities in breaking down woody tissues. The whole question of forest healthfulness or hygiene is intimately associated with soil conditions and particularly with the micro-flora present. Obviously this is a subject that should be given close study preparatory to any extensive afforestation program. With this in mind the microbiological aspects of forest soil formed an important part of the program at the last meeting of the Advisory Committee on Forestry held at the Southern Experiment Station, Maple, Ontario, in October, 1953. A list of the titles of papers<sup>1</sup> given at that meeting will indicate the range of discussion. It may be noted that Mr. W. R. Day, lecturer in forest pathology and hygiene at the Oxford Forestry School, was present, and gave a paper based on his wide experience in connection with afforestation in Great Britain, its title being "The Character of the Soil and its Relation to Root Infections and Stem Decays".

Of those presenting papers at that meeting, the following have received in the past or are receiving at the present time support for their research from the Council: Dr. V. Slankis, Dr. R. O. Earl, Dr. C. Heimbürger, and Dr. H. M. Good.

**(b) Forest Genetics:—**

Particular note should be made of the work in forest genetics being carried out by Dr. Heimbürger (Department of Lands and Forests), which is aimed at producing improved strains of our native species or the development of hybrids that should contribute much to the value of future plantations. In this connection it is of interest to note that in Sweden, one of the most advanced countries with respect to forestry development, research in forest tree-breeding and allied activities is supported to the extent of \$250,000 annually. Of this total, not more than 20 percent is a direct contribution from the government. Practically all of the remainder is provided by the forest industries either as direct contributions or from foundations that have derived their capital from these industries.

**(c) Photo-periodism:—**

Closely associated with Dr. Heimbürger's work is a study being undertaken at Glendon Hall by the University of Toronto on the effect of light

<sup>1</sup> Listed at the end of this report.



quality and length of daylight on frost hardness and tree growth. This is of significance in relation to the introduction of exotics or the transposition of desirable native species from one latitude to another, and also it is believed may contribute to the development of new techniques in relation to the forest genetics program. A report on this work by J. A. C. Grant is available.

#### (d) Seed Production:—

Over the past few years Professor Duff of the Department of Botany (University of Toronto) has been making studies of the physiology of red pine to determine as far as possible the factors affecting seed production with a view to providing information that may make it possible to have better control over the supply of seed from selected sources. A paper on one aspect of this work was published during the past year<sup>1</sup>.

#### (e) Planting Methods:—

As a result of the regeneration survey completed by Professor Hosie, it is apparent that on many of our better growing sites satisfactory regeneration can only be brought about by planting. His observations also indicate that plantations in the past have often been unsatisfactory due to a variety of causes including the quality of the nursery stock and the use of improper planting methods. With the support of the Research Council Professor Hosie is now making a comprehensive study of this problem.

### Co-operation between Agriculturists and Foresters

Among the factors that will affect the success of large-scale afforestation in southern Ontario is the proper classification of land according to its best use, whether for agriculture or forestry, and the closest possible co-operation between agriculturists and foresters in land-use planning. With the object of learning something of each other's problems and of the programs of research that are at present under way, and also of making a start for its closer co-operation in research undertakings, the two advisory committees of Agriculture and Forestry met together last May at the Ontario Agricultural College. The results of this meeting indicated that there is a considerable divergence of opinion between agriculturists and foresters on matters relating to the best utilization of sub-marginal agricultural land, and after the meeting the chairmen of the two committees were asked by Dr. Stratford to make a thorough investigation of the situation, and if feasible, recommend the setting up of a comprehensive study of land use in the southern part of the Province.

<sup>1</sup> Duff, G. H. and Nolan, N. J. Growth and morphogenesis in the Canadian forest species: 1. The controls of cambial and apical activity in *Pinus Resinosa*, reprinted from "Canadian Journal of Botany", pp. 471-513, 1953.



## Forest Economics

Among the factors contributing to the costs of the wood-using industries are taxes and other government charges. Some of these, such as stumpage and ground rent, are peculiar to these industries, and have continued and developed over the years without much consideration being given to their effect on the industries in question. Two studies by graduate students in the Faculty of Forestry on the relation of taxation to forest management have been completed—one (supported by the Research Council) on the effect of taxation on privately owned woodlots under the municipal system of southern Ontario, and the second on the taxation of the forest industries in Ontario. The results of the latter study are being published shortly<sup>1</sup>. Further studies of some of the economic factors affecting forestry in this Province are to be undertaken in the near future. In fact the first of these which has received support from the Research Council is nearing completion<sup>2</sup>.

## Wood Utilization

In this field there are three matters to which reference should be made:

### (a) Pilot plant requirements:—

A certain amount of work supported by the Research Council on the design and testing of sawmill equipment has been carried out in co-operation with the Forest Products Laboratory in Ottawa. An important problem in relation to nearly all wood utilization research and particularly that concerned with the development of manufacturing and processing equipment is the need for a pilot plant stage in order to determine how applicable the results of laboratory projects are in meeting industrial requirements. This is recognized as probably the most serious gap in the wood utilization research picture in Canada. The possible gains in this field are impressive, and the costs of necessary engineering and development programs are, of course, quite high.

### (b) Essential oils:—

In the past, with support from the Research Council, studies have been made at the Ontario Research Foundation on essential oils that may be obtained from the foliage of certain of our native conifers. The laboratory work has been completed and the results published. It is now proposed by the Research Division of the Department of Lands and Forests to investigate the commercial possibilities of these results in the field, and the study is to be commenced during the coming summer on the limits of the Ontario Paper Company near Heron Bay.

<sup>1</sup> Wilkes, G. C. Taxation of the Forest Industries in Ontario, University of Toronto Forestry Bulletin No. 3, University of Toronto Press, Toronto, pp. 102. 1954.

<sup>2</sup> Collicott, F. T. Some of the Economic Aspects of Sustained Yield Forestry. Thesis submitted in partial fulfilment of the requirements for the degree of Master of the Science of Forestry, University of Toronto. 1954.

(c) Wood Chemistry projects:—

In addition to the work on essential oils, projects that have been carried out at the Ontario Research Foundation with the support of the Council include the investigation of tanning agents, synthetic boards, and dispersing agents.

(i) Tanning Agents: During 1953 large-scale laboratory equipment was obtained for the purpose of manufacturing lignin tanning agents on a scale large enough for evaluation by industry in the re-tanning of chrome upper leather. This experiment has now been completed through the co-operation of a local tannery. The results obtained indicate that the leather produced with the lignin tanning agent is equivalent to that produced using vegetable tanning agents. A similar experiment is being carried out in a tannery in Oshawa, Ontario, to confirm this result.

The application of lignin tanning agents to sole leather is a more complex problem, although laboratory results indicate that satisfactory leathers can be obtained. This conclusion requires confirmation by industrial trials. It is, however, a much more difficult problem to carry out pilot plant tests on sole leathers, since the process is a counter-current one, and much larger quantities of material are required. The advisability of building a pilot plant capable of producing approximately 50 pounds of lignin tanning agent per day, which would be necessary for its evaluation on an industrial scale is now being considered.

(ii) Synthetic Boards: The project on the development of a thermosetting binder from waste sulphite liquor for the manufacture of synthetic boards from sawdust and shavings has been continued. Arrangements have been made to evaluate this binder with a small company in Ontario who operate a plant for producing synthetic boards from waste wood chips and urea-formaldehyde resin.

(iii) Dispersing Agents: Fundamental studies on the use of lignin dispersing agents for various chemical applications have been continued. Arrangements for field testing this material by an oil well drilling company have been unavoidably postponed.

In addition to the above development work, two fundamental investigations on the chlorination and phenolation of waste sulphite liquor respectively have been completed and the results reported in the technical literature. In addition considerable work has been carried out on the nature of the carbohydrates present in waste sulphite liquor and on methods of separating them from one another and from lignin.

List of papers presented at the Meeting of the Advisory Committee on Forestry, Research Council of Ontario, September 30th - October 1st, 1953.

1. "The Interest of the Forest Industry in Forest Pathology and Hygiene", G. G. Cosens, Kimberly-Clark Corporation.
2. "Forest Pathology and Hygiene in Nursery Practice" (Introductory), G. M. Linton, Ontario Department of Lands and Forests.

3. "Problems of Damping-off", J. Cockerill, Dominion Laboratory of Forest Pathology.
4. "Mycorrhizas and their Development in the Nursery", V. Slankis, Dominion Laboratory of Forest Pathology.
5. "Water Relations and Growth in Nursery Soils", L. J. Chapman, Ontario Research Foundation.
6. "Sick Soil, its Cause and the Properties of the Toxic Agent", R. O. Earl, Queen's University.
7. "Resistance to Disease in Planting Stock", C. C. Heimburger, Ontario Department of Lands and Forests.
8. "The Wood-Rotting Fungi under Succession", H. M. Good, Queen's University.
9. "Conditions of Life in the Soil and their Relation to the Health of Birch", D. R. Redmond, Forest Pathology Laboratory, Fredericton.
10. "The Character of the Soil and its Relation to Root Infections and Stem Decays", W. R. Day, Imperial Forestry Institute, University of Oxford.
11. "The Status and Development of Plant Pathology", D. L. Bailey, Department of Botany, University of Toronto.
12. "The Spread and Development of White Pine Blister Rust in Ontario", W. R. Haddow, Ontario Department of Lands and Forests.
13. "The Deterioration of Hardwoods in Eastern Canada", Rene Pomerleau, Laval University.
14. "Cull Studies in Relation to Forest Management", J. E. Bier, Division of Forest Biology, Science Service, Department of Agriculture.

## ADVISORY COMMITTEE ON HIGHWAYS RESEARCH

Chairman: Alan K. Hay

Since reporting to the Council in March 1953 we have held two meetings of the main committee, one of which included a field trip to the Toronto By-pass Highway project. Sub-committees and individual members have been in close touch with certain of the research projects of the Highways Department and we have had reports from observers on the full-scale test road project now under way in Idaho.

Assistance and encouragement is being given the staff of the Canadian Good Roads Association in an endeavour on their part to launch a scheme for making available published information on Highways and Highways research.

However, at the moment, we are not able to report any definite progress in the matter of securing an improved way of carrying out highway research in the Province.

Most of the research work is now being done by the Department of Highways. Our committee has continued to recommend for some time that much of this work should be carried out in a way which would throw part of the responsibility on the universities. If this could be accomplished it would not be done with the idea of imposing research activities on them but would assist their civil engineering departments to provide needed highway research men for highway problems and would stimulate teaching in this important field of engineering.

As in other fields the great need is for the training of workers and it would seem that such training should begin in the university.

On the other hand, the Department of Highways research activities are somewhat hampered by the fact that they are to a large extent carried out by a staff which must of necessity often give priority to urgent problems which occur in the current construction programme and which may have the effect of postponing active work on long-term research projects. It would be much better to divorce the research programme from ordinary routine construction and maintenance.

During the year the Committee has made a brief survey of state university organizations in the U.S. which are operating joint highway research projects with their local State Highway Departments. One of the most successful of these appears to be the joint highways research arrangement in Indiana between Purdue University and the State Highways Commission. From a modest beginning the project has developed an energetic programme involving an annual expenditure of \$300,000.

The Committee is arranging to secure additional data regarding operations at Purdue as it is felt that this particular set-up meets requirements very similar to those in Ontario.

However, it does not seem that as a committee we can do much more in the way of making specific recommendations until there is a greater indication of interest in the proposals by either Queen's University or the University of Toronto and by the Department of Highways.



# ADVISORY COMMITTEE ON INDUSTRIAL RESEARCH

Chairman: C. A. Pollock

Your Committee's Report, made one year ago, detailed re-organization plans and a new look at its objectives. The current year has seen the introduction of these ideas, but only a few steps taken toward implementation. However, what was done in 1953-54 shows the promising outlook inherent in these plans.

## Industrial Research Services

The sub-committee dealing with this department of the Ontario Research Foundation is headed by Mr. D. W. Stewart, Jr., and reports as follows:

Early in 1953, a long-considered move was made, integrating the Ontario Field Staff of the Technical Information Services of the National Research Council with the I.R.S. group<sup>1</sup>. In previous years, there had been a duplication of services at the call of industries in Ontario, which was somewhat confusing. The new arrangement eliminated all misunderstandings and also allowed a resumption at an adequate level of introductory and information calls, so valuable to small companies. In 1952 this work lagged, due to the pressure of field service for the industries with which contact had been made previously. The extra manpower also allowed more contacts to be made and more services rendered in Northern Ontario.

The joint staff now comprises seven men from I.R.S., three from T.I.S., two secretary-stenographers and the director, Colonel D. F. MacRae. These people are now grouped into five sections, one devoted to technical information services and introductory calls, and four to field services in the industrial operations of metallurgy, chemistry, textiles, and biochemistry, with facilities at the Ontario Research Foundation to do the laboratory work required. Specialization has meant more satisfactory service to industry and at the same time better internal functioning of the department.

The results achieved in 1953 show the following comparisons with the work performed in 1952:

Log Entries.....	New Clients	+ 55%
	Repeat Calls	+ 15%
Analysis of Contacts.....	Laboratory	- 30%
	Information	+ 60%
	Introductory	+ 80%
	Service	+ 20%
Visits to Industries .....		+ 30%

<sup>1</sup> The Department of Industrial Research Services of the Ontario Research Foundation.

These figures speak for themselves with the exception of the laboratory work which in number of contacts has decreased. In 1952 much laboratory testing was done, whereas in 1953 the character of the work changed so that more jobs were developmental in nature, requiring more man hours per unit reported.

One meeting of the sub-committees was devoted to a good look at how the I.R.S. operates. All members of the committee were well pleased with what was found, and commented favourably regarding the services available to Ontario industries. The aspects noted were:

1. Improvement in the character and quality of the services rendered;
2. The completeness and convenience of the filing system relating to clients, projects and scientific information sources;
3. The range of laboratory and library facilities, and the wealth of outside contacts available in Canada and other countries through I.R.S.;
4. The helpful attitudes of personnel;
5. The satisfactory working arrangements which I.R.S. has with many private consultants in Ontario.

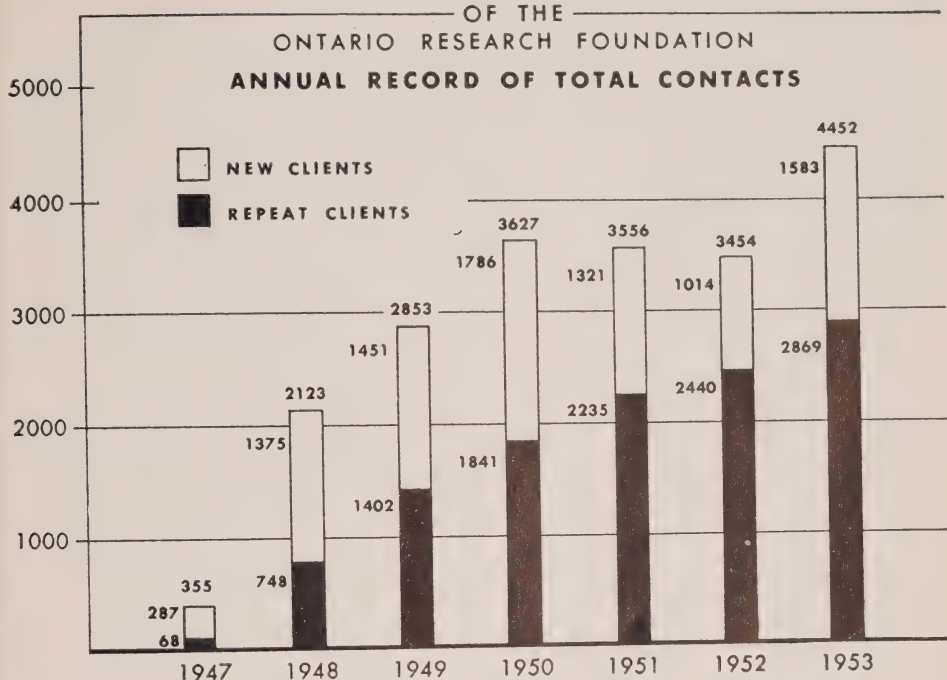
The growth in the demand for I.R.S. which is resulting has made very obvious to the Committee the fact that an extension of the I.R.S. itself will be necessary in the near future. A study of the situation will be made this coming year so that the Advisory Committee may make a recommendation to the Council as to what it thinks should be done. The study will include an investigation of the charges made for work done, of the possibility of support from industrial and trade associations, of the need for more personnel and more remuneration to the present staff, etc. Last year's report recommended an additional grant-in-aid of \$8,000 for the purpose of training replacement staff. The successful integration of T.I.S. with I.R.S. removed the necessity of these funds this year and for part of 1955. However, immediately thereafter the need for expansion and more funds will become urgent and the Committee's deliberations will have to take this situation into account.

### Group Research

The sub-committee for group research did not get under way during the year because a committee member could not be found to take the chairmanship. It is hoped that this situation will be rectified shortly.

Meanwhile, the group research work which is being carried on with the Electroplaters' Society has been very successful and is thoroughly approved by our committee member, Mr. Kergan Wells, who is in the plating business. His remarks regarding the work being done at the O.R.F. were most complimentary.

INDUSTRIAL RESEARCH SERVICES  
OF THE  
ONTARIO RESEARCH FOUNDATION  
**ANNUAL RECORD OF TOTAL CONTACTS**



Your Committee feels embarrassed by its lack of performance in the field of group research. Possible developments in other industries are being explored and investigated. The President of the Research Council has been very interested and has done his best to promote further action on our part. With a sub-committee chairman appointed, it is hoped that more satisfactory progress may be made.

### Publicity

Mr. Lorne Campbell, Chairman of the Sub-Committee on Publicity, reports the successful collaboration of the Canadian Manufacturers' Association at the Research Session of the C.M.A. Annual Meeting, May, 1953, in Toronto. Several articles pertinent to I.R.S. and O.R.F. have been published and the public platform has been used by members of the

staff on many occasions. The Committee could use more articles and material, but personnel who can do the writing unfortunately have little or no time available.

## Scholarships

Last year, the Industrial Committee recommended awarding several scholarships for studies dealing with the business and economic aspects of research activities in Ontario industries. We have been advised that in the past grants have been made only in the fields of science. It is still our hope that this matter be given further study by the Scholarship Committee of the Council.



## ADVISORY COMMITTEE ON INDUSTRIAL WASTE

Chairman: Prof. A. C. Plewes

A year has passed since the creation of the Air Pollution Division in the Ontario Research Foundation. This group has concentrated its effort on the analyses and sampling of air in and around Sarnia. During the year only the fixed station in Tecumseh Park was available for the major equipment. Investigations in the surrounding areas were confined to dust cans and high volume samplers. At the end of the year a mobile unit was operated with good effect to correlate data up and down wind from the fixed station. Equipment now in use in Sarnia includes twenty dust cans, two Thomas Autometers, two Bendix Aerovanes and a smoke and hydrogen sulphide recorder.

The study to date shows that the pollution in the residential area of Sarnia varies from medium to medium-low. In contrast the industrial area indicates medium-high pollution. It is hoped that future studies may permit an evaluation of the pollution created by shipping and loading operations rather than by the industrial plants themselves.

During the year two confidential surveys were commenced, one for the Canadian Industries plant at Maitland, and the other for the Imperial Chemical Industries unit at Millhaven, Ontario. No comment can be made of the results obtained; however, the object was to determine dust and air pollution before and after the commencement of plant operation.

Some mention must be made of the effort and action of the industrial concerns that are co-operating with the Research Foundation in the pollution study in Sarnia. In the past year the Cabot Carbon Ltd., Canadian Oil Companies Ltd., and Sun Oil Company have joined the co-operative venture with the original group made up of Imperial Oil Ltd., Dow Chemical Company and the Polymer Corporation Ltd. Under the able guidance of Mr. A. D. McRae this industrial group has made considerable progress in the elimination of much unnecessary waste normally discharged into air and water.

The thing that is most encouraging, however, is the cordial and realistic way in which these individuals work together in this project. Each is keenly aware of the importance of the overall undertaking and is willing to assume responsibility for the solution of an associate's problem. It should be mentioned here that the International Joint Commission has studied the Sarnia project, and has commended the industries for their effort. It is also important to note that an industrial group in Edmonton has asked for information from the Sarnia sub-committee so that they may organize a similar governmental and industrial joint venture.

The study of the problem of the effect of trade wastes on sewage disposal units has been continued at Queen's by Prof. J. D. Lee. Moneys

allocated a year ago have been used to change and install mechanical equipment in the sanitary laboratory in Kingston. It is hoped that the experimental program may begin in May, 1954.

During the past year the Ontario Research Foundation bought a gas analysis unit termed a "Titrilog", and this novel device was loaned to the Chemical Engineering Department at Queen's University for appraisal. Studies made there in the current session indicate that this unit will determine sulphur compounds quickly and accurately in amounts ranging from  $\frac{1}{2}$  to 5 ppm. The fact that the instrument will monitor quickly as well as indicate the type of sulphur offender will make it most useful in field studies.

The writer visited an air pollution convention in Baltimore in May, 1953, and was much impressed with the types of apparatus that are available for removal of dust from industrial gas streams. Concern was felt, however, for the lack of authoritative information on the efficiency of each unit. It is believed that if this Committee is to exert its maximum effect it should understand the end as well as the initial phases of relevant study; to this end it is planned to collect data from manufacturers and commercial users of dust and smoke anti-pollution equipment.

# ADVISORY COMMITTEE ON MINES, MINERALS AND METALLURGY

Chairman: Mr. N. F. Parkinson

Work sponsored by request of the Advisory Committee last year falls into three categories:

- (1) Projects carried out at various universities in Ontario;
- (2) Projects conducted by the Ontario Research Foundation;
- (3) Group research carried out under the joint auspices of the Ontario Mining Association and the Research Council of Ontario.

## Projects at Universities

Since the year 1947-48 the Advisory Committee on Mines, Minerals and Metallurgy has followed the progress of research in fundamental geophysics under the direction of Professor J. T. Wilson at the University of Toronto. Financial support totalling some \$45,000 has been made available over this period. The work has involved thermal, radioactive, gravity, magnetic and geophysical investigations, looking in the main towards the age determination of rocks making up the Precambrian shield in Ontario.

The Committee has satisfied itself that this research is important and in this they are supported by the opinion of the National Research Council, the Geological Survey of Canada, and Imperial Oil Limited, all of whom are also contributing substantial sums to the conduct of the investigation.

Results of Professor Wilson's researches have been reported extensively in published papers. Last year the Committee recommended a further \$6,000 to help support the program for 1954-55; while it is expected that aid from the other contributors mentioned above will total over \$16,000. In 1954-55 the work will continue in fundamental geophysics, especially age determination.

Another project at the University of Toronto, to commence in 1954-55, for which it is hoped support will be provided is the examination of a Simcoe County core by F. W. Beales. This core is one which was recovered during investigations conducted by the Dominion Gas Company where the drilling penetrated the paleozoic section of the Precambrian basement. The area is said to be of high economic importance for oil, gas, and gas storage possibilities; and it was the opinion of members of the Committee that the core should be examined and the data tabulated with care. The work is expected to conclude within the year.

Another research which may finish in 1954-55 is Professor A. E. McBryde's work on procedures for the separation of the salts of platinum

metals by the use of commercial ion exchange resins. In support of this project it has been stressed that every possible method of attack on the difficult problem of concentration and purification of the platinum metals ought to be utilized in order to assist in their complete recovery from ores. We are hopeful that some of our fundamental studies in their manner of occurrence in Ontario ores may also assist in this respect and illustrate a practical application of pure research.

Aid to Professor G. B. Langford's researches on mineralogy of radioactive minerals and compounds, which has received support from the Research Council since 1952, was concluded last year. Two further papers were published as a result of the year's work and two additional papers were being prepared. The knowledge concerning the mineralogy of radioactive compounds has been substantially increased by this project, though there still remain many unsolved fundamental problems which must be solved before our knowledge can be considered to be satisfactory and adequate.

The spectrographic studies of Canadian ores which Professor J. E. Hawley has been conducting at Queen's University since 1948 have resulted in extensive published reports. The methods and application developed by these researches have been applied commercially by several companies who have received assistance from the trained staff provided by Dr. Hawley. Certain of these companies have also contributed to the conduct of the work, and the Committee reached the conclusion last year that since much of the research has reached the stage of application, grants from the Research Council might be drawn to a close in 1954-55. For this reason a reduced grant was approved. However, it is expected that the work will continue along the following lines: (1) completion of spectrographic methods for analysis of silicate and carbonate rocks; (2) spectrographic study of siliceous intrusives, Sudbury area; (3) spectrographic study of Breccias, Sudbury area; (4) granitic rocks in eastern Ontario with special reference to uranium deposits—likely to extend into 1955-56; (5) trace element study of alterations in lead-zinc deposits; (6) quantitative study of lead-zinc ores in eastern Canada—possibly will be delayed till 1955-56.

At McMaster University, aid to Professor R. P. Graham's research on polarographic analysis of minerals and alloys is to be continued for 1954-55. Already a number of published reports have resulted from the work. Among these are papers on the mercury cathode and its application, determination of titanium in rocks and minerals, and polarographic determination of titanium in steels and nickel-base alloys. The movement of titanium in soil profiles is of interest to soil chemists and it is desirable to study the application of two new methods to the determination of titanium in soils, as well as other trace elements which are important for plant nutrition. Projects for 1954-55 also include study of a new method for determination of zirconium in steels of high impact resistance, and further investigation on the determination of constituents in nickel-base alloys. Besides leading to refinements in polarographic analyses, the project is



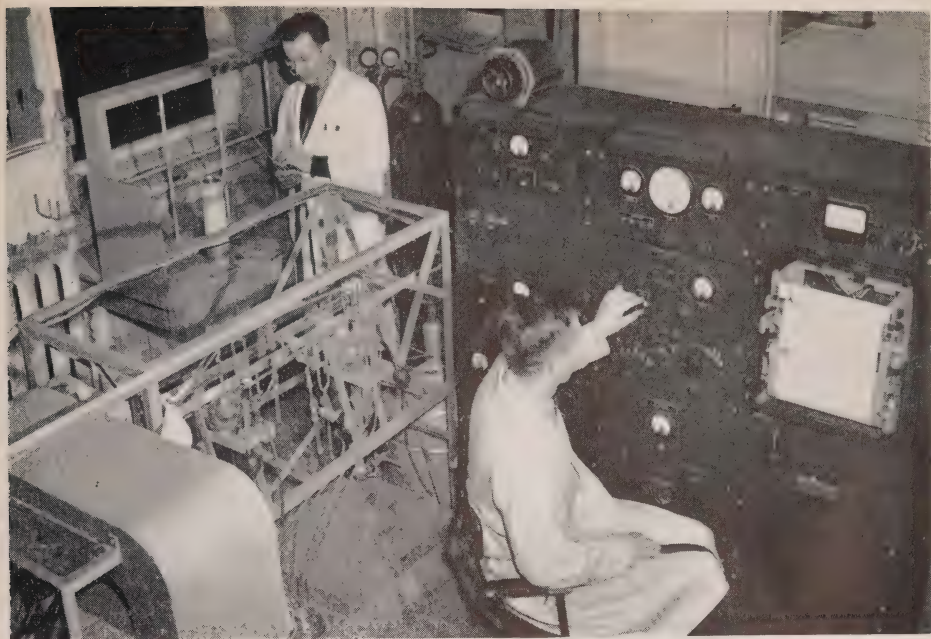


Photo: Fednews, Toronto.

Age determination of uranium and lead minerals, Geophysics Laboratory, Department of Physics, University of Toronto.

Top: the mas spectrometer, built at the University, measures relative amounts of different lead isotopes, which are related directly to the ages of minerals.

Below: finding the lead-210 content of uranium minerals, method used to give a second independent age determination.



providing training in methods which are of interest to many people in the Province.

The probe method of measuring conductivity, which has been under study at the University of Western Ontario by Professor A. D. Misener, will be completed during 1954 as far as Research Council support is concerned. Results of this investigation to date have been published.

At the same university Professor G. H. Reavely's study of pleistocene geology in southwestern Ontario was completed in 1953 and the results made available.

### Projects at Ontario Research Foundation

Council support was continued for three programs of work at the Foundation. These were in ferrous metallurgy, wire rope, and physics of metals.

Under the heading "ferrous metallurgy", Council support was continued for the project looking to the production of sponge iron from reduction of iron ores by use of brick kilns and more particularly to the production of controlled density steel from powder made from ore concentrates. In the main, however, this work was financed during the year by United States industry, who have been convinced of the possible industrial application, complete control in so far as the Canadian application is concerned being retained by the Foundation.

Work continued during the year utilizing the specially designed machine for the conduct of rope breaking tests: on investigation of the effect of sheave diameter on rope life; the establishment of optimum core densities, and investigation of effects of intermittent loading. In addition, some time was devoted to further investigation of the relationship between rope lay length and deterioration.

During 1954 it was planned to continue work on lay length investigations and to develop, if possible, a device which will permit recording lay length measurements of a rope in service and of the length comparable to that normally used in a mine. Work is also planned on the effect of pulsating loading on rope life.

The work on ferromagnetic domain patterns of silicon iron was concluded and the results were published in a paper by Dykstra and Martius—"Review of Modern Physics", January, 1953. As a consequence of the results obtained, the ferromagnetic domain technique was used to study recrystallization structures of nickel. The work, which has already given many interesting results, is still in progress. Furthermore, investigations into possible precision X-ray techniques were conducted and the divergent beam technique was found the most useful and promising technique for the detection of small lattice irregularities. This technique will be used in

conjunction with the ferromagnetic domain technique to investigate some fundamental properties of ferromagnetic substances.

Attempts to utilize the relationship between magnetic and mechanical properties led to the development of a magnetic "strain gauge". This work has reached the commercial development stage.

## Group Research

The project dealing with a non-destructive method of testing wire ropes has been supported for some years through a joint financing by the Ontario Mining Association and the Research Council. The conduct of the investigation is under the purview of the Wire Rope Committee of the Ontario Mining Association and the work itself is being conducted by contract with McPhar Engineering Company of Canada.

The work has included, first, laboratory research and, second, the construction of supersonic equipment for the testing and recording of changes in ropes in actual service brought about by deterioration caused by corrosion or wear. Some fifteen ropes in use in mine shafts have been examined and twelve of these have been later subjected to breaking tests by the Ontario Department of Mines. The resulting strength at various sections of the ropes have been correlated with results obtained by the non-destructive testing.

Up to the fall of 1953 considerable encouragement had resulted from the correlations obtained. Later, however, certain anomalies developed, and further field work was suspended until a laboratory study could be made to explain these distortions. Following this, alterations in equipment and changed techniques were adopted in the hope of satisfactorily coping with the anomalies. A program for 1954-55 was then established for the study of some seven ropes which are shortly to be removed from mines. Among these ropes are several which are likely to show deterioration similar to that affecting earlier ropes taken from the same shafts. It is hoped that a review of this new work may serve to indicate that the discrepancies previously noted may be now removed.

# APPENDIX I

## STATEMENT OF EXPENDITURE

### for the Year Ended 31st March, 1954

#### ADMINISTRATION:

Salaries .....	20,029.71	
Maintenance .....	5,153.10	
Travelling .....	6,674.23	31,857.04

SCHOLARSHIPS ..... 49,885.00

GROUP RESEARCH (Government share, 50%) ..... 18,870.29

#### GRANTS:

##### Ontario Research Foundation

Air pollution .....	21,052.56	
Ferrous Metallurgy .....	5,843.77	
Industrial Research Services .....	86,458.20	
Parasitology .....	41,820.16	
Physics of Metals .....	29,675.18	
Physiography .....	20,798.27	
Utilization of Agricultural Products .....	12,922.03	
Wire Rope .....	10,797.51	
Wood Chemistry .....	32,598.65	261,966.33

##### University of Toronto

Aerial Survey .....	1,440.00	
Agriculture .....	10,680.00	
Fisheries and Wildlife .....	32,520.00	
Forestry .....	30,468.00	
Mines .....	8,700.00	
Physics .....	10,440.00	94,248.00

##### McMaster University

Agriculture .....	3,600.00	
Fisheries and Wildlife .....	12,336.00	
Forestry .....	1,080.00	
Mines .....	1,200.00	
Physics .....	14,520.00	32,736.00

##### Queen's University

Fisheries .....	5,160.00	
Forestry .....	13,260.00	
Industrial Waste .....	4,680.00	
Mines .....	4,200.00	27,300.00

##### University of Western Ontario

Agriculture .....	2,640.00	
Fisheries and Wildlife .....	12,204.00	
Mines .....	1,800.00	16,644.00

##### Ontario Agricultural College

Agriculture .....	17,920.00	17,920.00
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##### Department of Agriculture

Agriculture .....	6,000.00	6,000.00
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##### Department of Lands and Forests

Fisheries and Wildlife .....	17,828.67	
Forestry .....	15,317.38	33,146.05
		489,960.38
		<u>590,572.71</u>



## APPENDIX II

### SCHOLARSHIP AWARDS 1953-54

Name	Field	Scholarship University	Amount
ALLAN, D. W.	Physics	University of Toronto	\$ 750.00
BADER, R. F. W.	Chemistry	McMaster University	750.00
BANCROFT, A. R.	Chemical Engineering	Queen's University	750.00
BARLOW, C. A.	Biology	University of Toronto	750.00
BASMADJIAN, D.	Chemical Engineering	University of Toronto	850.00
BENNETT, G. F.	Biology	University of Toronto	750.00
BIGELOW, C. C.	Chemistry	McMaster University	750.00
BOURNE, N. F.	Biology	University of Kiel	850.00
CAMPBELL, R. M.	Agricultural Engineering	Ontario Agricultural College	750.00
CHIDLEY, B. G.	Physics	McMaster University	750.00
CONKIE, W. R.	Physics	McGill University	750.00
CROWE, C.	Physics	University of Western Ontario	850.00
DEWDNEY, J. W.	Physics	McMaster University	1,000.00
DONNELLY, R. J.	Physics	Yale University	300.00
ELRICK, D. E.	Soil Physics	University of Wisconsin	750.00
EMREY, D. J.	Geology	Queen's University	900.00
FRANCIS, J. E.	Chemistry	Queen's University	750.00
FRASER, R. R.	Chemistry	University of Western Ontario	750.00
FULFORD, J. A.	Physics	University of Western Ontario	750.00
GEIGER, J. S.	Physics	Yale University	300.00
GRAHAM, K. C.	Chemistry	University of Western Ontario	750.00
GROENEVELD MEIJER, W.	Geology	Queen's University	1,000.00
HASTINGS, W. K.	Mathematics	University of Toronto	750.00
HAYES, E. R.	Chemistry	McMaster University	\$1,000.00
HAYNES, R. H.	Physics	McGill University	750.00
HOVNANIAN, V. P.	Chemical Engineering	University of Toronto	850.00
JUST, G.	Chemistry	University of Western Ontario	1,000.00
KENNETT, T. J.	Physics	McMaster University	750.00
KERR, J. T.	Physics	McMaster University	850.00
KNEELAND, D. R.	Physics	McMaster University	750.00
LEMON, R. R. H.	Geology	University of Toronto	850.00
McFARLANE, R. A.	Physics	McGill University	750.00
NABLO, S. V.	Physics	McMaster University	850.00
NEEDLER, MISS M. E.	Biology	University of Toronto	900.00
NELSON, C. D.	Biochemistry	University of Pennsylvania	1,000.00
PEMBERTON, R. H.	Geology	University of Wisconsin	750.00
PENGELLY, D. H.	Biology	Cornell University	1,000.00
PENNINGTON, E. M.	Physics	McMaster University	750.00
PETRUSKA, J. A.	Chemistry	McMaster University	750.00
PLEITER, D.	Physics	University of Western Ontario	1,000.00
PROUSE, MISS M. E.	Biology	University of Western Ontario	750.00
PYKE, R.	Mathematics	University of Washington	750.00

Name	Field	Scholarship University	Amount
QUINN, H. W.	Chemistry	Queen's University	750.00
RADVANYI, A.	Biology	University of British Columbia	900.00
REID, J.	Biology	University of Toronto	850.00
ROUSE, G. E.	Biology	Ohio State University	1,000.00
RUTHERFORD, K. G.	Chemistry	Wayne University	1,000.00
SHUMOVICH, W.	Biology	Ontario Agricultural College	750.00
SMITH, H. A.	Geography	University of Toronto	1,000.00
SNYDER, J. C.	Agricultural Economics	Purdue University	750.00
SPRAGUE, J. B.	Biology	University of Toronto	750.00
SPROTT, D. A.	Mathematics	University of Toronto	850.00
STEWART, T. W. W.	Physics	University of Western Ontario	750.00
STOREY, R. S.	Physics	Queen's University	850.00
STOTHERS, J. B.	Chemistry	University of Western Ontario	750.00
SUTTERLIN, P. G.	Geology	McMaster University	750.00
SZABO, A.	Physics	McGill University	750.00
TALMAN, J. D.	Physics	University of Western Ontario	750.00
TAYLOR, G. W.	Chemistry	Cambridge University	850.00
VAN DALEN, E.	Chemistry	McMaster University	750.00
VOIGT, MISS E.	Chemistry	McMaster University	750.00
WALLACE, L. V.	Physics	University of Western Ontario	750.00
WARREN, J. E.	Physics	McMaster University	750.00
WATKINS, M. S.	Mathematics	Massachusetts Institute of Technology	850.00
WESTON, V.	Mathematics	University of Toronto	750.00
WOLFE, R.	Physics	University of Bristol	1,000.00
WRIGGLESWORTH, L. A.	Geology	McMaster University	750.00
YOUNG, B. G.	Physics	University of Western Ontario	750.00
ZYSKIND, G.	Mathematics	University of Toronto	750.00

# APPENDIX III

## GRANTS IN AID OF RESEARCH

### AERIAL SURVEY

Maximum interpretability of aerial photographs .....	\$ 1,440.00
K. B. Jackson, University of Toronto	

### AGRICULTURE

Geography of Holland Marsh .....	2,400.00
D. F. Putnam, University of Toronto	
Enzyme studies .....	2,880.00
C. S. Hanes, University of Toronto	
Keeping of fruit juices .....	4,320.00
M. D. Smith, University of Toronto	
Soil micro-organisms, plant viruses, plant pathology .....	4,680.00
J. J. Miller, McMaster University	
D. MacClement, McMaster University	
D. L. Bailey, University of Toronto	
Field crop and horticultural problems .....	7,200.00
H. W. Caldwell, Ontario Agricultural College	
R. Keegan, Ontario Agricultural College	
B. H. MacNeill, Ontario Agricultural College	
F. H. Montgomery, Ontario Agricultural College	
Soil microflora .....	2,640.00
A. R. Walker, University of Western Ontario	
Food processing and storage .....	5,720.00
J. H. L. Truscott, Ontario Dept. of Agriculture	
Trace elements in soils .....	5,000.00
J. S. Shoemaker, Ontario Agricultural College	
Economics of feed grains .....	6,000.00
H. L. Patterson, Ontario Dept. of Agriculture	
Farm products utilization .....	12,900.00
L. Campbell, Ontario Research Foundation	
Climate and crops .....	20,800.00
L. Chapman, Ontario Research Foundation	

### FISHERIES AND WILDLIFE

Biological studies—mammals, insects, wild plants .....	10,680.00
J. R. Dymond, University of Toronto	
K. H. Rothfels, University of Toronto	
F. P. Ide, University of Toronto	
J. H. Soper, University of Toronto	
R. R. Langford, University of Toronto	
Fisheries bibliography and library .....	8,940.00
F. E. J. Fry, University of Toronto	
Studies of fishes, food and predators .....	8,700.00
F. E. J. Fry, University of Toronto	
R. R. Langford, University of Toronto	
Ontario mammals and fishes .....	4,200.00
F. A. Urquhart, Royal Ontario Museum of Zoology	
Biological studies at Lake Opinicon .....	5,160.00
J. F. Bendell, Queen's University	
J. R. Vallentyne, Queen's University	

Limnology of Rondeau Bay and Central Lake Erie .....	7,800.00
D. M. Scott, University of Western Ontario	
Biological studies—mammals, insects, fishes .....	4,400.00
R. H. Stinson, University of Western Ontario	
W. W. Judd, University of Western Ontario	
H. Battle, University of Western Ontario	
Studies of lake bottom sediments .....	7,050.00
H. Kleerekoper, McMaster University	
Biological studies—mammals, insects, wild plants .....	5,280.00
D. E. Delzell, McMaster University	
D. M. Davies, McMaster University	
L. Laking, McMaster University	
Fish and wildlife management .....	17,820.00
R. N. Johnston, Ontario Dept. of Lands and Forests	
Parasites in birds, fish, and mammals .....	41,820.00
A. M. Fallis, Ontario Research Foundation	

## FORESTRY

Chemistry of wood .....	4,790.00
R. R. McLaughlin, University of Toronto	
W. H. Rapson, University of Toronto	
W. F. Graydon, University of Toronto	
Tree physiology and pathology .....	8,880.00
G. H. Duff, University of Toronto	
Forest genetics and regeneration .....	13,200.00
J. W. B. Sisam, University of Toronto	
R. C. Hosie, University of Toronto	
Forest soils .....	6,810.00
R. N. Johnston, Ontario Dept. of Lands and Forests	
R. O. Earl, Queen's University	
Forest protection—studies of heart rot and insect devastation .....	7,860.00
H. M. Good, Queen's University	
A. S. West, Queen's University	
K. C. Fisher, University of Toronto	
Biochemistry of Canadian woods .....	4,440.00
G. Krotkov, Queen's University	
Forest production .....	10,425.00
R. N. Johnston, Ontario Dept. of Lands and Forests	
Chemical utilization of wood .....	32,600.00
H. B. Marshall, Ontario Research Foundation	
Miscellaneous studies—forest economics, basic chemistry .....	3,720.00
J. W. B. Sisam, University of Toronto	
A. N. Bourns, McMaster University	
G. E. McCasland, University of Toronto	

## INDUSTRIAL RESEARCH

Industrial Research Services .....	86,460.00
D. F. MacRae, Ontario Research Foundation	

## INDUSTRIAL WASTE

Effects of industrial wastes on sewage treatment .....	4,680.00
J. D. Lee, Queen's University	
A. C. Plewes, Queen's University	
Air Pollution .....	21,000.00
A. E. R. Westman, Ontario Research Foundation	



## MINES, MINERALS, METALLURGY

Radioactive minerals, platinum metals .....	2,700.00
G. B. Langford, University of Toronto	
W. A. E. McBryde, University of Toronto	
Geophysical investigations .....	6,000.00
J. T. Wilson, University of Toronto	
Spectrographic studies of Canadian ores .....	4,200.00
J. E. Hawley, Queen's University	
Polarographic analysis of alloys .....	1,200.00
R. P. Graham, McMaster University	
Geological studies .....	1,800.00
G. H. Reavely, University of Western Ontario	
Ferrous metallurgy .....	5,840.00
O. W. Ellis, Ontario Research Foundation	
Wire Rope .....	10,800.00
O. W. Ellis, Ontario Research Foundation	
Physics of metals .....	29,670.00
P. E. Cavanagh, Ontario Research Foundation	

## PHYSICS

Atomic mass measurements; decay of $\text{Ir}^{192}$ and $\text{Ir}^{194}$ .....	14,520.00
H. E. Duckworth, McMaster University	
M. W. Johns, McMaster University	
Low temperature physics .....	10,440.00
W. H. Watson, University of Toronto	
K. R. Atkins, University of Toronto	

# APPENDIX IV

## GROUP RESEARCH

Project Title	Co-operating Companies	Amount <sup>1</sup>
Non-destructive Testing of Wire Rope -	Ontario Mining Association -	\$ 3,890.21
St. Clair River Pollution - - - - -	Imperial Oil Limited Polymer Corporation Dow Chemical Company Canadian Oil Company Sun Oil Company Cabot Carbon Company - -	5,699.44
Silviculture - - - - -	The Ontario Paper Company Limited Abitibi Power and Paper Co. Limited - - - - -	3,250.00
Electroplating - - - - -	American Electroplaters' Society <sup>2</sup>	6,030.64
		<u>\$18,870.29</u>

<sup>1</sup> Research Council of Ontario share — 50%.

<sup>2</sup> Supported by the Canadian electroplaters through the American Electroplaters' Society.

## APPENDIX V

### ADVISORY COMMITTEES

#### AERIAL SURVEY RESEARCH

##### Main Committee:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
(Chairman)		
MR. J. A. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Dept. of Lands and Forests
MR. J. A. BRODIE	- -	Dept. of Lands and Forests
MR. L. J. CHAPMAN	- -	Ontario Research Foundation
DR. W. CLARK	- -	Eastman Kodak Co.
DR. D. R. DERRY	- -	Ventures Limited
MR. W. J. FULTON	- -	Dept. of Highways
DR. L. E. HOWLETT	- -	Physics, National Research Council
MR. M. E. HURST	- -	Dept. of Mines
MR. W. J. JACKSON	- -	Williamson Co. of Canada, Ltd.
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. S. T. B. LOSEE	- -	Abitibi Power and Paper Co., Ltd.
PROF. O. J. MARSHALL	- -	Civil Engineering, University of Toronto
PROF. F. F. MORWICK	- -	Soils, Ontario Agricultural College
PROF. J. E. REID	- -	Electrical Engineering, University of Toronto
MR. A. H. RICHARDSON	- -	Dept. of Planning and Development
MR. J. R. G. SMYTH	- -	Dept. of Lands and Forests

##### Executive:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
(Chairman)		
MR. W. J. FULTON	- -	Dept. of Highways
MR. M. E. HURST	- -	Dept. of Mines
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation
MR. A. H. RICHARDSON	- -	Dept. of Planning and Development

##### Meetings:

March 10, 1954, 39 Queen's Park, Toronto

##### Photography:

MR. J. A. M. AUSTIN	- -	Austin Airways Limited
MR. J. M. BISHOP	- -	Dept. of Lands and Forests
PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
MR. D. N. KENDALL	- -	Photographic Survey Corporation

##### Photogrammetry:

PROF. K. B. JACKSON	- -	Applied Physics, University of Toronto
MR. K. H. SIDDALL	- -	Dept. of Highways
MR. L. G. TIMPSON	- -	Dept. of Lands and Forests
PROF. W. M. TREADGOLD	- -	Civil Engineering, University of Toronto
MR. J. G. WILKINSON	- -	Photographic Survey Corporation

## AGRICULTURAL RESEARCH

### Main Committee:

PROF. G. N. RUHNKE	- -	Ontario Dept. of Agriculture
(Chairman)		
MR. A. M. BARR	- - -	Agricultural School, Kemptville
DR. W. H. COOK	- - -	Applied Biology, National Research Council
MR. H. CRAISE	- - -	Ontario Federation of Agriculture
MR. L. DAVIS	- - -	Ontario Federation of Agriculture
MR. J. A. GARNER	- - -	Ontario Dept. of Agriculture
MR. C. D. GRAHAM	- - -	Ontario Dept. of Agriculture
DR. E. S. HOPKINS	- - -	Canada Dept. of Agriculture
MR. R. H. JARDINE	- - -	Ontario Dairy Producers' Co-ordinating Board
DR. T. L. JONES	- - -	Ontario Veterinary College
MR. C. F. LUCKHAM	- - -	Ontario Federation of Agriculture
MR. CHARLES McINNIS	- - -	Ontario Hog Producers' Association
DR. J. D. MacLACHLAN	- - -	Ontario Agricultural College
MR. V. S. MILBURN	- - -	Ontario Federation of Agriculture
DR. K. W. NEATBY	- - -	Canada Dept. of Agriculture
DR. E. F. PALMER	- - -	Horticultural Experiment Station, Vineland
DR. H. L. PATTERSON	- - -	Ontario Dept. of Agriculture
DR. H. B. SPEAKMAN	- - -	Ontario Research Foundation
PROF. J. C. STECKLEY	- -	Western Ontario Agricultural School and Experimental Farm
MR. G. B. TEBO	- - -	Hydro-Electric Power Commission of Ontario

### Meetings:

May 22nd, 1953, Ontario Agricultural College, Guelph

Oct. 14-15th, 1953, Ottawa

### Agricultural Economics:

PROF. D. R. CAMPBELL	- -	Ontario Agricultural College
(Chairman)		
MR. H. K. LECKIE	- - -	The Industrial and Development Council of Canadian Meat Packers
(Secretary)		
DR. J. F. BOOTH	- - -	Canada Dept. of Agriculture
MR. H. CRAISE	- - -	Ontario Federation of Agriculture
PROF. F. W. P. JONES	- -	School of Business Administration, University of Western Ontario
MR. V. S. MILBURN	- - -	Ontario Federation of Agriculture
DR. C. V. PARKER	- - -	Dominion Bureau of Statistics
DR. H. L. PATTERSON	- - -	Ontario Dept. of Agriculture
MR. G. F. PERKIN	- - -	Ontario Dept. of Agriculture

### Meetings:

Nov. 12th, 1953, 39 Queen's Park, Toronto

### Agricultural Engineering:

MR. W. B. DENYES	- - -	Eastern Steel Products Limited
MR. L. M. FRANK	- - -	Eastern Steel Products Limited
(alternate to Mr. Denyes)		
PROF. C. G. E. DOWNING	-	Ontario Agricultural College
MR. WM. KALBFLEISCH	-	Canada Dept. of Agriculture
MR. M. H. McCURDY	-	Cockshutt Farm Equipment, Ltd.
MR. R. S. McMILLAN	- -	Pedlar People, Ltd.
MR. A. PITT	- - -	Massey-Harris-Ferguson Limited
MR. W. C. WOOD	- - -	W. C. Wood Co.
MR. S. M. YOUNG	- - -	International Harvester Co. of Canada, Ltd.

### Meetings:

April 22nd, 1953, 39 Queen's Park, Toronto



### Crops:

DR. D. N. HUNTLEY	-	-	Ontario Agricultural College
(Chairman)			
MR. A. H. MARTIN	-	-	Ontario Dept. of Agriculture
(Secretary)			
PROF. A. W. BAKER	-	-	Ontario Agricultural College
MR. A. M. BARR	-	-	Agricultural School, Kemptville
DR. R. O. BIBBEY	-	-	Ontario Agricultural College
MR. M. B. DAVIS	-	-	Canada Dept. of Agriculture
DR. C. H. GOULDEN	-	-	Canada Dept. of Agriculture
MR. CARR HATCH	-	-	Canadian Malting Co. Limited
MR. G. F. MANSON	-	-	Canada Dept. of Agriculture
DR. E. F. PALMER	-	-	Horticultural Experiment Station, Vineland
DR. P. O. RIPLEY	-	-	Canada Dept. of Agriculture
DR. J. S. SHOEMAKER	-	-	Ontario Agricultural College
PROF. J. C. STECKLEY	-	-	Western Ontario Agricultural School and Experimental Farm
DR. T. M. STEVENSON	-	-	Canada Dept. of Agriculture

### Meetings:

March 5th, 1954, 39 Queen's Park, Toronto

### Farm Animals:

DR. H. D. BRANION	-	-	Ontario Agricultural College
(Chairman)			
PROF. J. C. RENNIE	-	-	Ontario Agricultural College
(Secretary)			
MR. A. M. BARR	-	-	Agricultural School, Kemptville
PROF. J. R. CAVERS	-	-	Ontario Agricultural College
DR. A. R. G. EMSLIE	-	-	Canada Dept. of Agriculture
MR. H. S. GUTTERIDGE	-	-	Canada Dept. of Agriculture
DR. J. A. HENDERSON	-	-	Ontario Veterinary College
PROF. R. G. KNOX	-	-	Ontario Agricultural College
MR. C. F. LUCKHAM	-	-	Ontario Federation of Agriculture
DR. C. A. MITCHELL	-	-	Canada Dept. of Agriculture
DR. H. K. RASMUSSEN	-	-	Canada Dept. of Agriculture
DR. D. L. T. SMITH	-	-	Ontario Veterinary College
PROF. J. C. STECKLEY	-	-	Western Ontario Agricultural School and Experimental Farm
MR. W. P. WATSON	-	-	Ontario Dept. of Agriculture

### Meetings:

Feb. 24th, 1954, 39 Queen's Park, Toronto

### Food Processing:

DR. W. D. McFARLANE	-	-	Canadian Breweries Limited
(Chairman)			
MR. L. CAMPBELL	-	-	Ontario Research Foundation
(Secretary)			
MR. JOHN BAXTER	-	-	Baxter Canning Co.
MR. G. G. BRAMHILL	-	-	Ontario Dept. of Agriculture
PROF. L. R. BRYANT	-	-	Ontario Agricultural College
DR. W. H. COOK	-	-	Applied Biology, National Research Council
MR. J. H. HULSE	-	-	Defence Research Medical Laboratories
DR. R. K. LARMOUR	-	-	Maple Leaf Milling Co.
MR. EARLE S. MANNING	-	-	The Industrial & Development Council of Canadian Meat Packers

DR. H. B. SPEAKMAN	- -	Ontario Research Foundation
DR. J. H. L. TRUSCOTT	- -	Horticultural Experiment Station, Vineland

#### Meetings:

April 20th, 1953, 39 Queen's Park, Toronto

Jan. 5, 1954, 39 Queen's Park, Toronto

Feb. 24th, 1954, 39 Queen's Park, Toronto

#### Soils:

MR. L. J. CHAPMAN	- - -	Ontario Research Foundation
(Chairman)		
PROF. F. E. CHASE	- - -	Ontario Agricultural College
(Secretary)		
DR. H. J. ATKINSON	- - -	Canada Dept. of Agriculture
MR. A. M. BARR	- - -	Agricultural School, Kemptville
MR. W. J. P. CRESWICK	- - -	Dept. of Planning and Development
MR. G. A. HILLS	- - -	Dept. of Lands and Forests
MR. R. N. JOHNSTON	- - -	Dept. of Lands and Forests
MR. LAWRENCE KERR	- - -	Kerr Farms, Chatham
MR. G. LUSTIG	- - -	Dept. of Highways
DR. P. O. RIPLEY	- - -	Canada Dept. of Agriculture
PROF. N. R. RICHARDS	- - -	Ontario Agricultural College
DR. J. W. ROUATT	- - -	Canada Dept. of Agriculture
MR. JOHN SMART	- - -	Smart Bros., Collingwood
PROF. J. C. STECKLEY	- - -	Western Ontario Agricultural School and Experimental Farm
DR. W. H. UPSHALL	- - -	Horticultural Experiment Station, Vineland

#### Meetings:

Sept. 16th, 1953, Ontario Research Foundation, Toronto

March 23rd, 1954, Ontario Agricultural College, Guelph

## FISHERIES AND WILDLIFE RESEARCH

#### Main Committee:

DR. J. R. DYMOND	- - -	Zoology, University of Toronto
(Chairman)		
DR. A. M. FALLIS	- - -	Ontario Research Foundation
(Secretary)		
DR. H. I. BATTLE	- - -	Zoology and Applied Biology, University of Western Ontario
DR. A. O. BLACKHURST	- - -	Ontario Federation of Commercial Fishermen
PROF. A. F. COVENTRY	- - -	Zoology, University of Toronto
DR. C. D. FOWLE	- - -	Dept. of Lands and Forests
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. H. M. GOOD	- - -	Biology, Queen's University
DR. W. J. K. HARKNESS	- - -	Dept. of Lands and Forests
MR. L. HUGHES	- - -	Northern Ontario Outfitters' Association
DR. F. P. IDE	- - -	Zoology, University of Toronto
MR. R. N. JOHNSTON	- - -	Dept. of Lands and Forests
DR. H. KLEEREKOPER	- - -	Zoology, McMaster University
MR. CARL F. KOLBE	- - -	Ontario Federation of Commercial Fishermen
DR. R. R. LANGFORD	- - -	Zoology, University of Toronto
MR. H. H. MacKAY	- - -	Dept. of Lands and Forests
MR. CECIL MARTIN	- - -	Port Dover, Ontario
MR. K. M. MAYALL	- - -	Dept. of Planning and Development

DR. N. W. RADFORTH	- -	Botany, McMaster University
DR. DAVID M. SCOTT	- -	Zoology and Applied Biology, University of Western Ontario
DR. J. H. SOPER	- - -	Botany, University of Toronto
DR. F. A. URQUHART	- -	Royal Ontario Museum of Zoology
MR. C. A. WALKINSHAW	-	Midland, Ontario

#### Meetings:

Nov. 21st, 1953, 39 Queen's Park, Toronto  
 Feb. 25th, 1954, Queen's University, Kingston

#### Executive:

DR. J. R. DYMOND	- - -	Zoology, University of Toronto (Chairman)
DR. A. M. FALLIS	- - -	Ontario Research Foundation (Secretary)
PROF. A. F. COVENTRY	- -	Zoology, University of Toronto
DR. F. E. J. FRY	- - -	Zoology, University of Toronto
DR. W. J. K. HARKNESS	- -	Dept. of Lands and Forests
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
DR. N. W. RADFORTH	- -	Botany, McMaster University

#### Meetings:

Jan. 16th, 1954, 39 Queen's Park, Toronto  
 Feb. 15th, 1954, 39 Queen's Park, Toronto

#### Publicity:

MR. K. M. MAYALL	- - -	Dept. of Planning and Development (Chairman)
MR. A. L. FENWICK	- - -	Dept. of Lands and Forests
DR. N. W. RADFORTH	- -	Botany, McMaster University

#### Research on Botanical Subjects in Relation to Wildlife:

DR. J. H. SOPER	- - -	Botany, University of Toronto (Chairman)
MR. N. S. BALDWIN	- - -	Dept. of Lands and Forests
DR. J. F. S. BENDELL	- -	Biology, Queen's University
DR. R. O. BIBBEY	- -	Ontario Agricultural College
DR. C. H. D. CLARKE	- -	Dept. of Lands and Forests
MR. F. S. COOK	- - -	Botany, University of Western Ontario
DR. C. D. FOWLE	- -	Dept. of Lands and Forests
DR. W. J. K. HARKNESS	-	Dept. of Lands and Forests (alternate to Dr. Clarke)
MR. K. M. MAYALL	- - -	Dept. of Planning and Development
DR. N. W. RADFORTH	- -	Botany, McMaster University
MR. C. R. TILT	- - -	Dept. of Lands and Forests

#### Meetings:

June 1st, 1953, Ontario Research Foundation, Toronto

#### FORESTRY RESEARCH

##### Main Committee:

✓ DEAN J. W. B. SISAM	- -	Forestry, University of Toronto (Chairman)
✓ DR. H. B. MARSHALL	- -	Ontario Research Foundation (Secretary)

✓ MR. A. S. L. BARNES	- -	Dept. of Planning and Development
✓ DR. R. M. BELYEA	- -	Forest Insect Laboratory, Sault Ste. Marie
✓ MR. W. A. DELAHEY	- -	Consulting Forester, Toronto
2 - PROF. C. G. E. DOWNING	- -	Ontario Agricultural College
<del>✓</del> PROF. G. H. DUFF	- -	Botany, University of Toronto
✓ DEAN R. O. EARL	- -	Faculty of Arts, Queen's University <i>Prof.</i>
MR. J. H. GODDEN	- -	Great Lakes Paper Company <i>Dagen</i>
✓ MR. GORDON GODWIN	- -	The Ontario Paper Co. Limited
✓ MR. J. D. B. HARRISON	- -	Dept. of Northern Affairs and National Resources
✓ DR. O. HOLDEN	- -	Hydro-Electric Power Commission of Ontario
✓ PROF. R. C. HOSIE	- -	Forestry, University of Toronto
✓ COL. J. H. JENKINS	- -	Dept. of Northern Affairs and National Resources
2 MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
✓ MAJ. GEN. H. KENNEDY	- -	Consulting Engineer, Ottawa
<del>✓</del> MR. A. KOROMEFF	- -	Pulp and Paper Research Institute of Canada
<del>✓</del> MR. W. J. LeCLAIR	- -	Canadian Lumbermen's Association
MR. A. P. LESLIE	- -	Dept. of Lands and Forests
<del>✓</del> MR. D. A. MACDONALD	- -	Dept. of Northern Affairs and National Resources
✓ MR. J. B. MATTHEWS	- -	Abitibi Power and Paper Company Ltd.
<del>✓</del> MR. S. T. B. LOSEE	- -	Abitibi Power and Paper Company Ltd.
(alternate to Mr. Matthews)		
<del>✓</del> DEAN R. R. McLAUGHLIN	- -	Applied Science and Engineering, University of Toronto
✓ MR. C. R. MILLS	- -	Ontario Forest Industries Association
✓ MR. G. W. PHIPPS	- -	Kimberly-Clark Corporation
✓ MR. K. O. ROOS	- -	Booth Lumber Limited
MR. S. J. STANFORTH	- -	Staniforth Lumber & Veneer Limited
DR. G. H. TOMLINSON II	- -	Howard Smith Paper Mills Limited
✓ DR. L. T. WHITE	- -	Dominion Laboratory of Forest Pathology

#### Meetings:

May 20th, 1953, Ontario Agricultural College, Guelph

Sept. 30th - Oct. 1st, 1953, Southern Experiment Station, Maple and University of Toronto

#### Executive:

DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
(Chairman)		
DR. H. B. MARSHALL	- -	Ontario Research Foundation
(Secretary)		
MR. A. S. L. BARNES	- -	Dept. of Planning and Development
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests
MR. J. B. MATTHEWS	- -	Abitibi Power and Paper Company Ltd.
DEAN R. R. McLAUGHLIN	- -	Applied Science and Engineering, University of Toronto

#### Meetings:

April 13th, 1953, 39 Queen's Park, Toronto

Sept. 28th, 1953, 39 Queen's Park, Toronto

Nov. 10th, 1953, 39 Queen's Park, Toronto

Dec. 11th, 1953, 39 Queen's Park, Toronto

Jan. 18th, 1954, 39 Queen's Park, Toronto

#### Wood Chemistry:

DR. H. B. MARSHALL	- -	Ontario Research Foundation
(Chairman)		
DR. G. A. ADAMS	- -	Applied Biology, National Research Council
DR. F. BENDER	- -	Forest Products Laboratory
DR. R. M. DORLAND	- -	Abitibi Power and Paper Company Ltd.



DR. G. A. LEDINGHAM	- -	National Research Council Regional Laboratory, Saskatoon
DEAN R. R. McLAUGHLIN	-	Applied Science and Engineering, University of Toronto
DR. C. A. SANKEY	- -	Ontario Paper Company, Limited
DR. G. H. TOMLINSON, II	-	Howard Smith Paper Mills Limited

#### Meetings:

July 6, 1953, Ottawa

#### Forest Biology:

MR. A. P. LESLIE	- - -	Dept. of Lands and Forests (Chairman)
MR. A. B. BAIRD	- - -	Canada Dept. of Agriculture
PROF. G. H. DUFF	- - -	Botany, University of Toronto
DEAN R. O. EARL	- - -	Faculty of Arts, Queen's University
PROF. R. C. HOSIE	- - -	Forestry, University of Toronto
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MR. G. W. PHIPPS	- - -	Kimberly-Clark Corporation
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
MR. W. E. WILLSON	- - -	Abitibi Power and Paper Company Ltd.

#### Meetings:

May 7th, 1953, 39 Queen's Park, Toronto

#### Sawmilling Practice:

MR. W. J. LeCLAIR	- - -	Canadian Lumbermen's Association (Chairman)
COL. J. H. JENKINS	- - -	Dept. of Northern Affairs and National Resources
DR. H. B. MARSHALL	- -	Ontario Research Foundation
MR. T. A. McELHANNEY	-	Grimsby, Ontario
MR. K. O. ROOS	- - -	Booth Lumber Limited
MR. J. F. SHARPE	- - -	Dept. of Lands and Forests
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto
MR. S. J. STANFORTH	- -	Staniforth Lumber & Veneer Limited
MR. G. J. THOMSON	- -	Peter Thomson & Sons

#### Forest Research in Northwestern Ontario:

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MR. G. H. D. BEDELL	- -	Dept. of Northern Affairs and National Resources
MR. J. H. GODDEN	- -	The Great Lakes Paper Company Limited
MR. K. HEARNDEN	- -	Abitibi Power and Paper Company Ltd.
MR. H. O. KANTOLA	- -	Newaygo Timber Company Limited
MR. GEO. R. SONLEY	- -	Marathon Paper Mills of Canada Limited
MR. J. B. THOMAS	- -	Forest Insect Laboratory
MR. P. ADDISON	- - -	Dept. of Lands and Forests (ex officio)
MR. T. S. JONES	- - -	Thunder Bay Timber Operators' Association (ex officio)
MR. R. N. JOHNSTON	- -	Dept. of Lands and Forests (ex officio)
DEAN J. W. B. SISAM	- -	Forestry, University of Toronto (ex officio)

## HIGHWAYS RESEARCH

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(Chairman)		
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(Secretary)		
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MR. ANDREW BOYER	- - -	Ontario Good Roads Association
(ex officio)		
MR. D. E. McQUIGGE	- - -	Ontario Roadbuilders' Association
(ex officio)		

### Meetings:

May 14th, 1953, 39 Queen's Park, Toronto

Feb. 25th, 1954, Ontario Research Foundation, Toronto

### Executive:

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MR. C. G. SAUNDERS	-	-	-	Dept. of Highways
MR. J. WALTER	-	-	-	Dept. of Highways

## INDUSTRIAL RESEARCH

### Main Committee:

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(Vice-Chairman)				
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(Secretary)				
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MR. HOWARD CHAMBERLAIN	-	-	-	Lowe Brothers Co. Ltd.
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MR. J. N. SWINDEN	- -	Great Lakes Lumber and Shipping, Ltd.
MR. KERGAN WELLS	- -	W. W. Wells, Limited

**Meetings:**

May 8th, 1953, Hart House, University of Toronto, Toronto  
Dec. 11th, 1953, Hart House, University of Toronto, Toronto

**Group Research:**

MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries Ltd.
DR. H. B. SPEAKMAN	- -	Ontario Research Foundation
DR. R. K. STRATFORD	- -	Imperial Oil Limited
MR. D. B. STRUDLEY	- -	Imperial Furniture Mfg. Co. Limited
MR. KERGAN WELLS	- -	W. W. Wells, Limited

**Meetings:**

Dec. 11th, 1953, 39 Queen's Park, Toronto

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(Chairman)		
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MR. G. C. BERNARD	- - -	Canadian Manufacturers' Association Inc.
(ex officio)		
COL. D. F. MacRAE	- - -	Ontario Research Foundation
(ex officio)		
MR. C. A. POLLOCK	- - -	Dominion Electrohome Industries, Ltd.
(ex officio)		
DR. H. B. SPEAKMAN	- -	Ontario Research Foundation
(ex officio)		

**Meetings:**

Dec. 11th, 1953, 39 Queen's Park, Toronto

**INDUSTRIAL WASTE RESEARCH**

**Main Committee:**

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MR. W. C. MILLER	-	-	-	City Engineer, St. Thomas, Ont.
DR. H. B. SPEAKMAN	-	-	-	Ontario Research Foundation

**Meetings:**

April 10th, 1953, 39 Queen's Park, Toronto  
 July 3rd, 1953, 39 Queen's Park, Toronto  
 Oct. 2nd, 1953, 39 Queen's Park, Toronto  
 Nov. 20th, 1953, 39 Queen's Park, Toronto  
 Jan. 22nd, 1954, 39 Queen's Park, Toronto

**St. Clair River Pollution:**

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(Chairman, 1953-54)				
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**MINES, MINERALS AND METALLURGY RESEARCH**

**Main Committee:**

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(Chairman)				
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PROF. H. S. ARMSTRONG	-	-	-	Geology, McMaster University
PROF. O. A. CARSON	-	-	-	Metallurgy, Queen's University
DR. O. W. ELLIS	-	-	-	Ontario Research Foundation
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PROF. J. E. HAWLEY	-	-	-	Mineralogy, Queen's University
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PROF. L. M. PIDGEON	-	-	-	Metallurgical Engineering, University of Toronto
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MR. R. H. RIMMER	-	-	-	Aluminium Laboratories Ltd.
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DR. D. G. WATT	-	-	-	Hydro-Electric Power Commission of Ontario
DR. C. R. WHITTEMORE	-	-	-	Deloro Smelting & Refining Co. Ltd.
DR. G. E. WILLEY	-	-	-	Algoma Steel Corporation, Ltd.
PROF. J. T. WILSON	-	-	-	Physics, University of Toronto

**Meetings:**

March 3rd, 1954, 39 Queen's Park, Toronto

**Executive:**

MR. N. F. PARKINSON	-	-	-	Ontario Mining Association
(Chairman)				
DR. O. W. ELLIS	-	-	-	Ontario Research Foundation
DR. G. S. FARNHAM	-	-	-	The International Nickel Company of Canada Limited

PROF. G. B. LANGFORD - - Geological Sciences, University of Toronto  
 MR. H. C. RICKABY - - - Dept. of Mines  
 DR. C. R. WHITTEMORE - - Deloro Smelting & Refining Co. Ltd.

**Meetings:**

April 29th, 1953, 39 Queen's Park, Toronto  
 Jan. 20th, 1954, 39 Queen's Park, Toronto

**Wire Rope:**

DR. O. W. ELLIS - - - - Ontario Research Foundation  
 (Chairman)  
 MR. W. E. BAWDEN - - - Dept. of Mines  
 MR. N. B. BROWN - - - Dept. of Mines and Technical Surveys  
 MR. W. E. BROWN - - - B. Greening Wire Co. Ltd.  
 MR. R. E. DYE - - - - Dome Mines Ltd.  
 MR. A. C. HALFERDAHL - - National Research Council  
 MR. R. L. HEALY - - - - Wright-Hargreaves Mines Ltd.  
 MR. W. B. KITCHEN - - - Plymouth Cordage Co.  
 MR. J. G. MORROW - - - Steel Company of Canada Ltd.  
 MR. R. D. PARKER - - - International Nickel Co. of Canada, Ltd.  
 MR. N. F. PARKINSON - - Ontario Mining Association  
 MR. R. S. SEGSWORTH - - General Engineering Co. (Canada) Ltd.  
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**Meetings:**

Feb. 17th, 1954, Ontario Research Foundation, Toronto

**Ferrous Metallurgy:**

DR. O. W. ELLIS - - - - Ontario Research Foundation  
 (Chairman)  
 MR. P. E. CAVANAGH - - Ontario Research Foundation  
 (Secretary)  
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 MR. F. A. LOOSLEY - - - Dominion Foundries and Steel Ltd.  
 MR. W. SAMUEL - - - - Steep Rock Iron Mines Ltd.  
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 MR. D. G. WATT - - - - Hydro-Electric Power Commission of Ontario  
 DR. G. E. WILLEY - - - Electro-Metallurgical Corporation  
 MR. T. H. ADAIR - - - - Atlas Steel Company  
 (Co-operating)  
 PROF. G. LETENDRE - - - Laval University  
 (Co-operating)  
 MR. J. S. McMAHAN - - - Steel Company of Canada Ltd.  
 (Co-operating)  
 DR. NORMAN PARLEE - - - Dominion Steel and Coal Co.  
 (Co-operating)  
 MR. N. F. PARKINSON - - Ontario Mining Association  
 (ex officio)

**Meetings:**

June 5th, 1953, Ontario Research Foundation, Toronto

### Geology:

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(Chairman)			
MR. J. O. GORMAN	-	-	Hydro-Electric Power Commission of Ontario
PROF. J. E. HAWLEY	-	-	Mineralogy, Queen's University
DR. D. F. HEWITT	-	-	Dept. of Mines
MR. M. E. HURST	-	-	Dept. of Mines
DR. H. S. SCOTT	-	-	Physics, McMaster University

### Non-Ferrous Metallurgy:

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(Chairman)			
DR. O. W. ELLIS	-	-	Ontario Research Foundation
DR. G. S. FARNHAM	-	-	International Nickel Co. of Canada, Ltd.
MR. W. M. GOODWIN	-	-	Dept. of Mines and Technical Surveys
MR. L. J. LICHTY	-	-	Ventures, Limited
DR. L. M. PIDGEON	-	-	Metallurgical Engineering, University of Toronto
MR. M. J. TAMPLIN	-	-	Ventures, Limited















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